IT351: VIRTUAL DRESSING ROOM

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***Abstract*—Due to the busy lifestyle, people switched to the online mode of shopping to buy ready-made clothes, which sometimes fit them and sometimes not. Till now, all the online systems for buying clothes provide 2-D images of clothing, which does not tell the right fit for the customer. To surmount this problem, the clothing industry experimented and undertook many studies to narrow down the gap which exists between fabric choice and size, and final purchased item, by introducing a "Virtual Dressing Room". In this paper, we discuss the structural design of AR "Virtual Dressing Rooms" for the real-time simulation of 3D fabrics and its implementation. The system uses the sensor which is Microsoft Kinect V2 as a depth sensor, to achieve the user's body parameter measurement, which includes developing the chest, hip, waist, thigh, and unique design for each user. 3D measurements such as knee circumference are included. The clothing size category is selected based on the measurement of each of the customer. Unity 3D Game Engine has been integrated so that users can overlay 3D clothes in real time. The system also includes gesture controllers, while taking in account the gender of the customer to showcase variety of clothes. The developed model has successfully increased the physically selected dress pattern according to physical movements performed by the user, thus providing a virtual fitting room which seems real.**

I. INTRODUCTION

Currently, physically trying clothes are very difficult as it is turning out to be a time-consuming process. Even with the assistance of shops' employees, it can be difficult to find best clothes that fits the customer. On behalf of the seller, it is arduous and also time consuming to remove all the wrong clothes by customers. In the online shopping systems, it is almost next to impossible to find a suitable cloth design when looking at some 2D images of clothes. This is where our virtual dressing room come into play, enabling users to try virtually different outfits in front of the big screen. This solution enables users to choose outfits that will fit in a short period of time with an efficient experience. Published in 2018, the research work resulted in enhancing exploratory behaviour both online, off-line. Also, it was used to increase promotion and purchase intentions. It showed that a website having Virtual Fitting Room (VFR), increased consumers' curiosity about the product and the intention to purchase the product. This research shows that virtual fitting room supports consumers to buy clothing items with increased satisfaction. Nowadays, virtual reality and mixed reality play a big role in overcoming many current issues in everyday life. In these types of applications, the depth of information plays an important role. Therefore, RGB-D sensors are popularly used for development. Some recently published research studies in robotic navigation, virtual laboratories for education and home automation, where RGB-D sensors are highly used for development.

In the work that we have proposed below, we aimed to come up with a solution that could provide great ease and satisfaction. And this can be achieved by applying the experience in a more realistic manner, in which the client prompts the apparel using the same depth sensor as the movements performed. The proposed system was developed while keeping in mind the reducing costs and hardware components, supporting 3 Dimensional models of local fabric design to increase scalability. For implementing the model, we used Microsoft's Kinect V2, equipped with different types of sensors that detected depth using IR sensor, used camera sensor to capture RGB images (video frames), and captured audio using an inbuilt microphone array. Kinect sensors have an internal processor for processing and converting data before it is sent to the SDK (Software Development Kit), which reduces the workload on the PC side. The proposed system has two applications. The Windows Presentation Foundation (WPF) application captures the dimensions of the user's body and extends the textile pattern on the user in front of the Unity 3D application device. Some of the Body parameters such as length between shoulders, height, arm length and length from neck to hip, are calculated by including the keen skeletal joints. Some of the Complex body parameters such as the circumference at the chest, hip, waist, thigh and knee are calculated using the info obtained from the depth sensors of the connector. The behaviour of a single depth sensor for measuring human body parameters was also being investigated. At this point of time, the choice of fabric size

range is based on the optimal measurement of the aforementioned body parameters. Subsequently, filtered 3Dimensional cloth models populate the sliding bar, where users can try on available commands using genetic commands. The selected model is mounted on the user in a real-time video stream. The results depicts that a single depth sensor can be successfully used for the proposed AR virtual fitting room.

II. LITERATURE SURVEY

The Paper [2] mainly focuses on user output in video streaming, skin color detection and model alignment. Uses modules for positioning joints, rotation and scaling to align 2D fabric models with the user. Uses Microsoft Kinect and WPF(Window presentation foundation to capture the user physical measurements). The Kinect sensor in particular offers three streams: image streaming, depth resolution and audio streams, in a range found from 1.2 to 3.5 m. In this phase, the first two streams have been used to develop the human model, fabrication and GUI. Within the API, the Skeleton API provides details about the location of users standing in front of the sensor list, with detailed location and distribution details. The Proposed method also create new joint points apart from kinect sensor found in order to get precise and appropriate data that was needed.

The Paper [3] performs the initial size estimation. Next, in Virtual Dressing Room, customize user-friendly clothing from a limited size. The user chooses the required dress item to wear out of the list. After selecting a costume, a user image is available. For a particular image, an image of the selected outfits is placed at the user's location.

In the paper [4] retexturing algorithm is used with the help of Microsoft Kinect V2 camera that provides depth information and color. The shirt was distinguished by the image based on its depth and the texture of the handmade marks. The depth and 3D coordination of the display image were used to create a texture map from the face of the shirt to the photo with the image of the new texture. The new texture implant is made using a line extension of luminance information.

The Paper [5] extracts and separates the user from the background to create an AR virtual environment. To differentiate the front, they used depth images and user details provided by the Microsoft Kinect sensor V2. The orthopedic tracker measures the spatial coordination and depth of the joints. They used nine body parts to fit the fabric model onto the user's skeleton model. They smoothen the spatial coordination to minimize vibration and blurring in the joints. They calculated the angle between the joints to set the rotation angle of the parts of the fabric model.

One of the major contributions of the paper [6] is that they automatically create an invisible (or virtual) avatar based on user's skin color and body size and use it for appropriate clothing, alignment, and mimicry in our visual-system experiment.

III. PROBLEM STATEMENT

To propose a real time virtual try on system with the help of Microsoft Kinect V2 which can help user to choose perfectly fitting cloths for them without having to wear and check each cloth item and thus reducing their shopping time.

A. Objectives

- **To find best fitting clothing item for the user.**
- **To make online shopping more powerful.**
- **To reduce time and labour of the user while shopping.**

IV. METHODOLOGY

In the developed virtual dressing room there are two main steps: non-contact user body parameter measurement and three-dimensional overlap cloth on user, this all in real time. Microsoft Kinect V2 depth sensors were used to collect the required user body parameters. Added Unity for 3D Game Engine, the 3D Cloth model is overlapping on the users's image. A model of the proposed system is shown below in Figure 1. The gesture recognition capability built into the system enables the user to virtually try different clothing items.

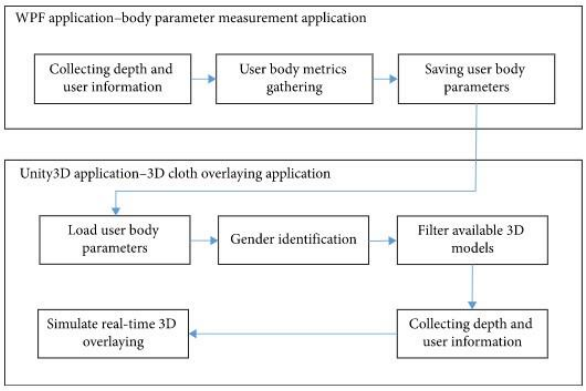

Fig. 1. Proposed System

Application for Measuring Body Parameter: To attain the user's body parameters using a depth sensor, we used the C language to write the WPF (Windows Presentation Foundation) program. This application gathers the required physical parameters of the user that is positioned in front of the Microsoft Kinect sensor. After the model is started, the Kinect sensor starts capturing the natural data through its IR depth sensor and RGB camera. Later, sensor middleware eliminates background noise and based on several methods related to image processing, it described moving objects. The app directs the user to save the T-pose to begin the physical parameter estimation process (Figure 2). The required parameters of the body of the dress such as arm length, shoulder height, height, inseam, and bone length, and other proper distances of the joints were calculated using the direct Kinect application program faces (API). The Kinect V2 sensor captures 25 skeleton joints (Fig. 3) for mapping the human body where it uses both RGB space and IR space details. The

TABLE I
SUMMARY OF LITERATURE SURVEY

Authors	Methodology	Merits	Limitations
Masri et al.	Works on live video stream	Gives a good ideaof fitting	Only 2D clothing supported
R. Nakamura et al.	Works on video stream with the help of 2 kinects	High level of accuracy	Uses 2 kinects
Traumann et al.	Based on Retexturing Algorithm	Highly refined texture based Algorithm	Increased time complexity
S. Giovanni et al.	Based on offline preprocessing	High clarity	Uses an additional HD camera

required bone grafting was taken into account, among these 25 bone points, for the calculation of the required physical parameters.

Application of Unity3D - The 3D Cloth Overlaying Application: The obtained body parameters are applied for a 3D

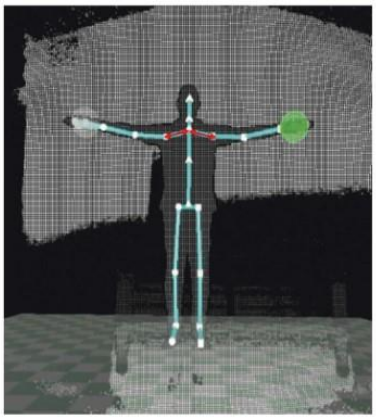

Fig. 2. Skeletal T-pose

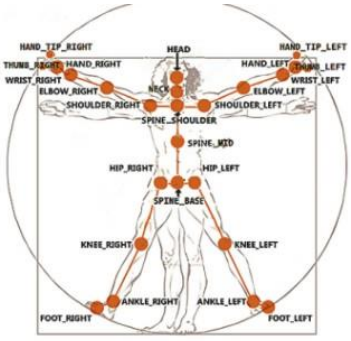

Fig. 3. Human Torso Mapping

textile application created using the Unity3D game engine. Initially, depending on the body parameters, the appropriate category of customer costume is then identified. In the Windows Presentation Foundation (WPF) app, when we are done with selecting the gender of the user, the body image frame is moved to the peripheral sensing service. After that, the 3D fabric models are sorted according to the size of the garments and the gender. The proposed system contains a database of model 3D clothing items designs. The same database also contains corresponding tag value for all 3D fabric models, which tells us the gender and category of clothing size. When gender is set by the customer 3D dress models are filtered based on size and gender depending on the availability of clothing items in that particular store. We assumed 2D / 3D models of clothing either sex dress is available in advance. We used free 3D costume models that were open source and easily available from the Internet. For every costume models (depending on skeletal angles), we keep a set of pivots (e.g. markers or anchor points). The main purpose of such handbags is to synchronize clothing or objects to a user-tracked track or 2D user image. For now moment, our system only supports a limited amount of men and women clothing items. Men's things are trouser, Shirt, hat and tie. Women's clothing items include handbag, skirt, and trousers.

V. RESULTS AND ANALYSIS

In this section, we discuss the tests we performed to verify the design of Virtual Dressing Room system. It supports real live data from the Microsoft Kinect sensor. This is how we examine the effectiveness of the proposed scheme.

Figure 4 shows the user interface that has been created. After capturing the required 3D data, the size section of the clothes is done. Finally, the overlay system is initialized with all the measurement parameters to filter 3D-based fabric models. The output of a version of the program is presented in Figure 5. Here, the customer can select and almost experiment with clothing available in the shopping mall, which is filtered according to their body parameters. Items in the list and the menu options can be selected using touch-point attributes combined with the solution.

Fig. 4. The Menu / UI

Also, the proposed system may have delays or congestion. In short, this occurs when the user performs a fast motion, during the alignment process. This is probably due to a sync problem of the Microsoft Kinect camera between RGB radio and maximum depth. It may be other times when there will

Fig. 5. Some Screen Shots of the output display

be no proper alignment of objects and user body. The Kinect depth sensor depends on the use of the inward and outward reception, available exposure light, which will affect user acquisition joints and bones. Essentially, it resulted in the proposed system that can track customer encounters; therefore, the model will return to its original state pending associated members are missing to be retrieved. Other reason is likely that the customer's body may be out of Kinect view field (e.g. standing in range that is less than 0.5 meters, or stands a short distance away or 8 meters from the sensor, or not all body parts by a Kinect sensor is detected, say due to prominence).

VI. CONCLUSION

In this proposed project, our team has made use of only one RGB-D Microsoft sensor which is Kinect V2 to get measurements of customer's body which include some 3D measurements like that of waist, thigh, etc. to develop a more realistic virtual fitting room. The app successfully uses actual physics images on the outfit, according to the user-generated physical movement, to provide a tailored experience.

INDUVIDUAL CONTRIBUTION

The individual contribution and weekly sequence of tasks are depicted in the below Gantt Chart.

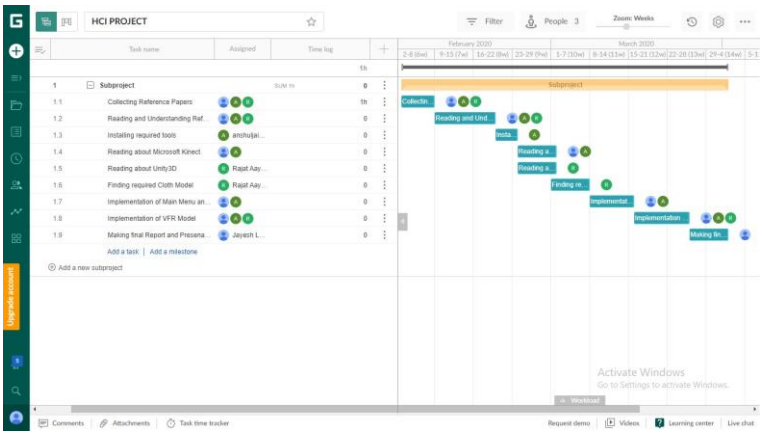

Fig. 6. Gantt Chart

IMPLEMENTED/BASE PAPER

K. M. A. Yousef, B. J. Mohd and M. AL-Omari, "KinectBased Virtual Try-on System: A Case Study," 2019 IEEE Jordan International Joint Conference on Electrical Engineering and Information Technology (JEEIT), Amman, Jordan, 2019, pp. 91-96, doi: 10.1109/JEEIT.2019.8717498.

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