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INTELLIGENT VIRTUAL FITTING ROOM A FUTURE TECHNOLOGY APPROACH

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ABSTRACT— **The virtual fitting room is built on the main technologies: augmented reality and Microsoft Kinect. Augmented reality allows the customers to select a garment off the rack without having to try it on physically. As a customer, you see yourself on screen with a 3D copy of a dress. Microsoft Kinect allows the user to control the program by simple gestures pushing virtual buttons right in the air. The built-in camera tracks a person's body and superimposes over it a 3D model of the dress. This unique feature that allows the customers to watch both the front and the back parts of the dress is deployed in the fitting room for the first time in the future shopping. In this paper the main objective is to build a framework for trialing the cloth virtually and to overcome the main challenge, the drawbacks in the existing system (i.e.) Area limitation, scaling, superimposing and to improve the accuracy.**

INDEX TERMS— Kinect, 3D image, Virtual fitting, skeleton detection, augmented reality.

I. INTRODUCTION AND RELATED WORK

Virtual reality is an artificial environment which is created with software and presented to the user in such a way that the user suspends belief and accepts it as a real environment. On a computer, virtual reality is primarily experienced through two of the five senses: sight and sound. Augmented Reality and Virtual Reality are two hot topics which are trending in the world of technology, but there is more to it than what meets the eye. It could possibly redefine the way we "see" and "touch" things in the future. It has garnered so much attention in recent times and the trust of so many tech-giants, who are investing top dollars in developing this technology [1] [2] [3]. It enables shoppers to try on clothes to check one or more of size, fit or style, but virtually rather than physically. A fit technology may be categorized according to the problem that it resolves or according to the technological approach. Shopping for clothes is a common daily activity both in-store and online. An in-store shopper usually tries on some selected clothes and examines how well they fit. While an online shopper usually checks how well the

clothes fit the models in the online pictures [2]. The related work on virtual fitting room and the main drawbacks to overcome in the proposed system are summarized in the following paragraphs.

Nutan Kumari et.al., (2015) proposed the application which is used to improve accessibility of trying clothes and maximizing the time efficiency by introducing a virtual fitting room environment [1]. The system users can use from their home itself. The system which makes use of web camera to detect human body .In order to superimpose the cloth image on the human body, resizing of the image is done. This system consists of 5 main modules: User extraction, skin segmentation, haar classifier, integral image, classifiers cascaded. Using the camera, the user image is captured and extraction is done. After extracting the image, the threshold is given only on the pixels. Then the areas on the background which is similar with the skin color are not processed. Object detection is done using Haar classifier. A rectangular feature of an image is calculated using an intermediate representation of an image. If the original image is essential image, then the integral image is computed. The extracted image is used to find the accuracy of the classifier. It can detect human faces at a rate of five frames per second. The obtained result shows that this device will capture the real-time motion pictures.

Umut Gultepe et.al., (2014) proposed the virtual fitting room framework using a depth sensor [2]. The bone splitting technique as it looks like a real render the body parts near the joints. The body bone information is extracted from the input. Body measurements are used to estimate the location of joints and bones. Depth map filtering is done. Depth mapping is analyzing the Image in depth in order to estimate the size. Body dimension estimation for cloth resizing is done in order to obtain the body height and shoulder width. Motion smoothing: under this process position filtering and rotation filtering and constraints is processed. Finally bone splitting is applied. The obtained results can be used in many applications in shopping malls.

The main objective of this paper is to get rid of hidden cameras which is more danger for women's life. In order to prevent from skin disease as customers trials the cloth. If the cloth doesn't fit to the customer then return to the garments will be more, so in order to lower the rate of returns. Inorder to make customers happy and satisfied. More helpful for the customers to trial clothes virtually rather than physically. In this paper the clear concept of kinect and real time virtual fitting setup is explained and developed.

The rest of this paper is organized as follows. Section II describes the whole system framework. Section III, IV describes the algorithms and techniques used in the proposed system. Section V describes the expected outputs. Section VI concludes the paper.

II.FRAMEWORK

The framework of the system is shown in Figure.1.As shown in figure, framework can be divided into two phases. First, the user is captured by the kinect camera. The depth of user is calculated using RGB D sensor and by IR camera. The main algorithm used is structured light principle to identify the depth measurements of the user which is more useful for superimposing cloth virtually on user. After that using an ensemble of classifiers the user data information is predicted. Then the user's skeleton is being tracked and detected along with that joint estimation is found. Second, inorder to looks real time augmented reality is used. Then 3D reconstruction is designed. And finally the alignment of the dress with the user is done by scaling and superimposing. The above mentioned two phases is discussed in detail in the following sections.

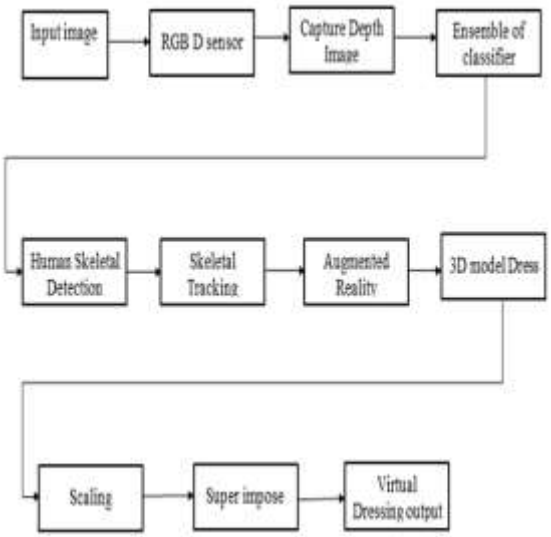


Figure.1 Proposed system framework

III.SKELETON DETECTION AND TRACKING

In this section, the process is to identify the depth image and the body measurement of the user. This identification will be more helpful for the user to trial the cloth which is fit to them correctly. So in order to find the depth of the image and body measurements the module and the methods used is as follows,

- RGB D Sensor
- Capturing the depth of the image
- Ensemble classifier
- Human skeletal detection and tracking

Person (User) stands before the virtual mirror. The device named Kinect which is developed by Microsoft have connected with virtual mirror. Kinect system consists of RGB D and IR sensor. Now the rays emits from the IR incident on person and reflected back to the system. From that the depth information is calculated. Now RGB and the IR image forms 3D image in the screen. Now to calculate the body measurements and to find the posture of the person, skeletal detection and tracking method is used. Using ensemble classifiers, the data collected from the input by using the voting techniques, the prediction is made regarding user.

Kinect is a camera which is developed by Microsoft. It consists of three main components, color camera, IR camera and microphone array. Color camera is RGB D sensor, in which D is used to find depth information for each pixel . The main input streams of the kinect are color, depth, infrared, human body and audio.

RGB D sensor consists of two sensors. The RGB and the IR sensor. These two sensors calculate the depth of the image in a 3D image. It captures the 640 x 480 pixels at 31 frames per second. The flow of capturing the depth image as follows in Figure 2.

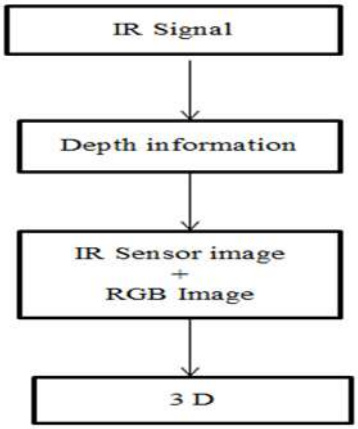
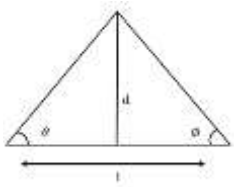


Figure .2 Flow diagram for depth image

Depth sensor consists of IR paperor and IR camera. The principle used to calculate the depth is structured light principle. This principle works on traingulation method. The traingulation calculation is given in Eq.1

$$d = \frac{l \sin(\theta) \sin(\emptyset)}{\sin(\theta + \emptyset)}$$



Eq.1.Traingulation calculation

Ensemble of classifiers is learning and training method. Group of data's of the human information is collected and have trained with kinect.So,this training method helps the kinect to provide accurate results of the user's measurements by using voting and prediction method. The process is explained in Figure.3.

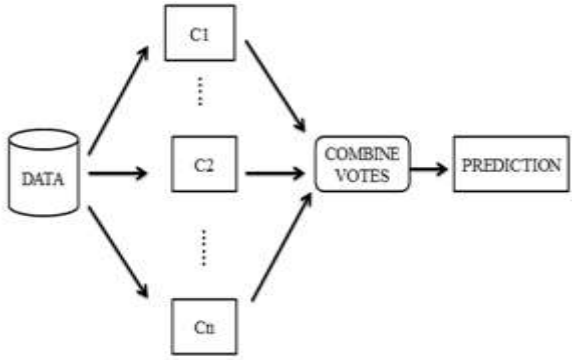


Figure.3 Ensemble classifier process

The main algorithm used in this classifier is random forest algorithm (Figure 4). This algorithm works on decision tree. Using the combination of learning models,it will check with each tree.The output depends on the individual tree.The final result depends on the combination of training and testing.

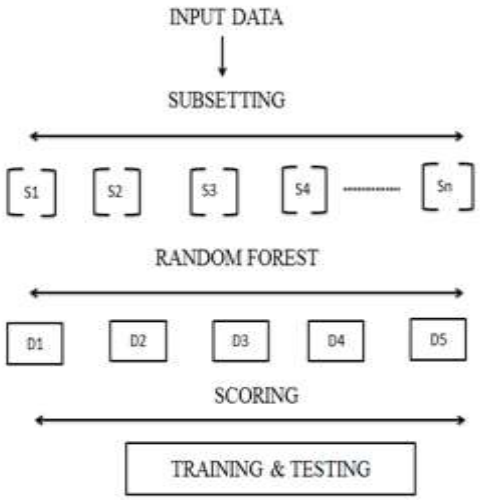


Figure.4 Random forest algorithm

Based on group of classifiers output, the human skeleton is detected. After detecting the joints, line is marked over the input image. The efficient approach to track the object is the mean shift algorithm. Using clustering techniques the joint position is estimated. After that depth and joint estimation is matched with each other.

Now the skeleton system is detected and tracked. Now the user's physical measurements are ready for the next process.

IV.VIRTUAL FITTING SETUP

After finding the measurements of the user next process is scaling and superimposing.

Augmented reality is a type of virtual reality. It combines the real world and virtual layer together to look the output natural (Figure 5). It is mainly used to avoid markers, the line which is marked over the skeletal image.

Figure 5 Augmented reality

Reconstruction of 3D model is done using input image. Collection of RGB and depth image, 3D model of the dress is designed. By taking the multiple views using the 3D sensing device, which is around 360 degree it gets registered in the database. After registration the 3D model dress will view in the screen.

For the 3D dress model, the algorithm used is marching cube algorithm. It generates the triangular mesh. Then 3D points were divided into number of cubes. From that each cube intersects the surface in different manners. It calculates the normal vector of surface at each vertex of triangle. There are 15 possible ways to intersect the cube. According to this algorithm the 3D model dress is designed.

Scaling is next step of this setup. Now the dresses will be rolled in the below of the screen. The user can choose their concerned dress by waving their hands. According to the gesture movement one by one dress will viewed in the screen. The dress will superimpose over the user image. Increasing and decreasing the size of the dress according to the user measurements by scaling.

Based on human skeletal 3D dress will be scaled. Increasing or decreasing in size is done according to distance of the user.It will fit exactly to the size of skeleton. The Eq.2 used for scaling is,

$$DS = \frac{S\ model}{Z\ spine}$$

Eq.2 Scaling

S model represents the vector of default width and height and Z spine represents the distance of spine the user to sensor. Now the superimposing of the dress with the user is done by overlapping. The algorithm used for superimposing is linear blending skinning algorithm.

V.EXPERIMENTAL RESULTS

The simulated outcomes are elaborated with the help of the corresponding simulation results obtained. In the Visual studio 2013 the program is typed and after it simulated the blank screen appears as shown in Figure 6.

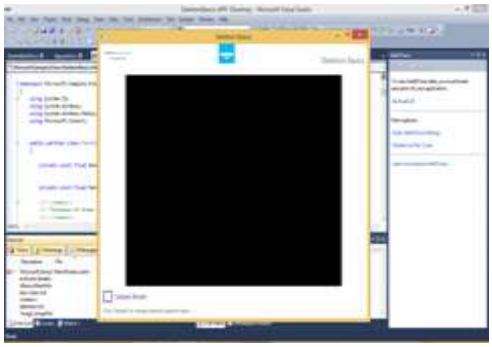


Figure 6 Skeleton tracking window

The input image that is user stands in front of the kinect camera and user detection is identified as shown in Figure 7.

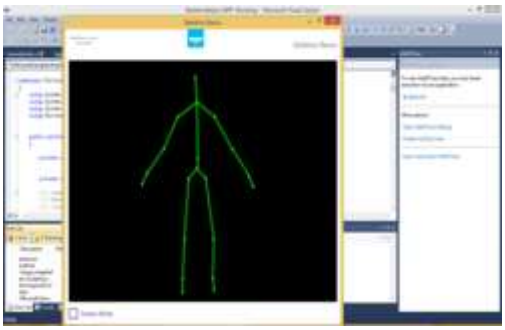


Figure 7 User detection

The user skeleton gets detected and tracking is done. The skeleton gets tracked after being tracked in different frames. Once the user gets detected the tracking process will start. The following Figure 8 shows the different positions of the user.

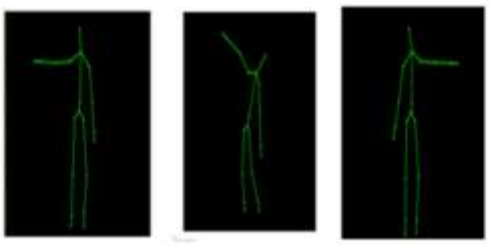


Figure 8 Different positions

VI. CONCLUSIONS

Virtual fitting room is a very intelligent system in this upcoming modern technology. This system is a very good solution for the garments and in the shopping malls. Kinect offers an accurate solution for the virtual fitting room. This system is an improvement to the existing system where the area limitation, scaling and superimposing have been improved. The customers can trial the cloth virtually and make themselves feel happy and much satisfied with their purchasing.

The future work can be done regarding this paper is, this system can be implemented for the online user.

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