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VDresser - Interactive Virtual Try on Clothing Design System

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Abstract - The busy life spent in today's world has put limitations to humans and time has become the most precious of all. Due to this matter the process of purchasing a suitable apparel consumes a huge amount of time and energy with a lot of other difficulties to be faced. The implemented system introduced an advanced methodology which is presented for the purchase of clothing through a virtual fit on platform, which consumes far more less time than the normal process, making it easier for the both seller and customer. This provides a realistic behaviour for the suitability of the garment's details. The whole process starts from an image of the user which is captured from the system which then and there provides an environment of a virtual dressing room. Customers are able to select clothing designs from a range of different garments as they prefer and those can be tried onto the image which allows them to experience a live view of the outfit as if it worn on their own body. The primary aim of this project was to build up a compelling, interactive and highly realistic shopping experience via a desktop application providing the user a reliable and accurate service to access an environment of a virtual dressing room.

Keywords- Image Processing, Augmented Reality, Virtual Reality, Virtual Try-On, Visualization, Graphical Marketing.

I. INTRODUCTION

Nowadays, consumers with their increasing desire for individuality make high demands within the services sector. Specially, people want to get a good value easily almost at any time and at any place while claiming a wide range of goods, a high degree of individuality as well as quality and service at the highest level. Handling such immense demands will only be possible, if new fundamental technologies for the presentation, selection and try out of products will be developed in order to supplement the classical selling process. In particular, in the garment field, the virtualization of familiar paradigms including a virtual try-on leads to the creation of virtual shop environments which, for the first time, allow offering a wide range of individualized clothing while additionally enhancing shopping experience and customer support.

The process of purchasing a suitable garment consumes a huge amount of time and energy in the life of a human being. Many approaches have been tried in the not so distant past to make it possible to simultaneously answer two fundamental shopper concerns: "does it suit" and "does it fit", therefore reducing much of the guesswork involved in shopping. Currently most implementations are either incorporate, pure, two dimensional (2D) figures or oversimplified Three Dimensional (3D) computer-based mannequins, so that the customer will hardly be able to recognize himself / herself. Furthermore at present the typical visualization and simulation of garments is not giving any meaningful feedback to the "look and feel" of the selected cloth. Particularly the garments are rendered independent of the customer's size giving an idea that they always seem to fit. Therefore, no real decision support is given to the customer. Questions like "How does the garment really look like?", "Does it look good, when I'm wearing the cloth?" cannot be answered as well as concerns related to fit and sizing cannot be resolved. In particular, in the context of online shopping, after receiving the ordered garments customers often are disappointed or unsatisfied. This, in turn, leads to high product return rates as well as future indecision to purchase garments over the internet.

Therefore, the goals defined within the Vdresser project aim at an optimal support of the customer in decision making and thus to minimize time and costs for users, manufacturers and retailers. The rise in technology has made it possible to create a system like a virtual dressing room for customers to try on clothes in a shopping/clothing outlet with the particular system. The idea provides customers to see how well the clothes can actually fit before making a purchase decision.

The virtual try-on scenario can help customers to speed up the process for trying on various clothing styles. Generally, customers choose clothes based on their personal sizes and preferences. Many factors including culture, fashion, style, body figure, and experience would influence the preference of clothing selections. The realistic representation of virtual try-on requires suitable clothes to fit to human body. Due to the variety of body shapes involved in individuals, it costs a lot for manufacturers to make the sufficient clothing sizes to meet every individual's preference with desired fit. Thus, it is important to evaluate how different-sized clothes can actually fit on the human body. The objective of this study aims to evaluate the clothing fit on human body by dressing virtual clothes on live user images. Based on the clothing simulation, the human body dressed in different clothing sizes are tested for assuring a satisfactory fit. Finally, the clothing fit evaluation can provide useful information for clothing products in apparel industry as well.

II. BACKGROUND

The search for perfect clothing fit has a long history relating to various efforts to determine body anthropometry for the development of patterns and garments in the clothing industry.

Gray, S. (1998), has describes the challenges with garments not fitting consumer body shapes correctly in a retail stores. The Virtuosi project created virtual mannequins. The eventual goal of this project was a virtual studio that could be used by a designer who would be able to work on a mannequin [1].

Kjaerside, K et al. (2005), has presented a tag based approach which requires manual labelling of body parts in order to generate an augmented reality of the customer wearing a cloth simulation. Use of shape descriptors such as Histograms of Oriented Gradients (HOG) can also be an option for identification of the user and body posture estimation [2].

Onishi, K. and Takiguchi, T. (2008), has initiated a HOG based approach to estimate human postures as discrete states. Before extracting the HOG feature, the human region has to be detected by using the background subtraction method on the input image. In order to make the HOG feature insensitive to the clothes and the facial expression, they use the unsigned orientation of the image gradient computed algorithm [3].

Shotton, J. and Fitzgibbon, A. (2011), have developed a time human pose recognition system which is also available in the Microsoft Research Kinect SDK that predicts the 3D positions of body joints from a single depth image. They used algorithms such as density estimator per body part and mode finding approach based on mean shift with a weighted Gaussian kernel [4].

There were a number of products manufactured by various other entities. Those are as Topshop, Virtual Mirror and Swivel.

In Topshop user has to pose with their arms above their heads and allow for the Kinect to take a photo. User can use gestures to choose the clothes he/she wants to try. Once selected, the clothes selected by the user are pasted onto the picture taken before. It works on just on a single image [5].

Virtual mirrors also known as virtual dressing rooms. As mentioned above however not much work has been done on attempting the problem of colour change and texture projection for shirt. Although virtual mirror is a successful project, it has a lot of limitations when using this system by a user. The system required that a green shirt be worn and that there be texture on the shirt in the region where the texture had to be changed. Due to these limitations this is not applicable to any plain any colour shirt.

In Swivel an avatar is used instead of a real person. A large collection is available on digital library where the user can choose for their preference. Since an avatar is used it's not very impressive [6].

III. METHODOLOGY

When considering the development pattern of the research, the development team decided that prototype model is suitable for the development of the system. Prototype model helps to eliminate ambiguities and improve accuracy in interpretation of system requirements and functionality and build the system that result in a high quality, cost-effective, within time and efficient application that is cheap to maintain, easy to enhance and that can work effectively. It is divided in several phases and each phase comprised of multiple steps, and they are as follows: [7].

- Planning
- Analysis
- Design
- Implementation

A. Planning

In this phase project team identified why VDresser should be built and determined how the project team will go about building it.

Identifying project value – Project need is identified. The value that can be gained by using this system is to provide the users a virtual dressing room experience which makes shopping easier and reliable. The basic functionalities that are expected from VDresser were also clearly identified.

B. Analysis

The aim of the Requirement Gathering and Analysis phase was to identify the exact requirements of the VDresser. For that an identification of requirement specification and a correlation of functional activities need to be collected, the primary data were gathered by the questionnaire from various types of people in the fashion shops and customers. By analysing the primary data, the Vdresser team was identified the VDresser system is a basic requirement to perform customer need of a virtual fit-on room experience.

As an overall result of the questionnaire according to figure 01. Before the system was implemented, there were 93.8% users like with the change of the dressing rooms into virtual dressing system.

Fig. 1. Overall Result before Implementation

The secondary data were gathered from past similar researches. The current systems such as Topshop, Swivel and Virtual mirrors has two dimensional figures and 3D computer-based mannequins and other similar systems were identified as secondary data and how they operate, their strengths and weaknesses and came up with a solution that is the proposed system; VDresser. Which overcomes all prevailing problems in the identified systems.

C. Design

The primary objective of the design phase was to create a design that satisfies the agreed application requirements. In this stage, the team developed and designed diagrams.

Architecture design – An important step during this stage was the planning about the hardware, software and communications infrastructure for VDresser. This will be further explained by a System Architecture figure 02.

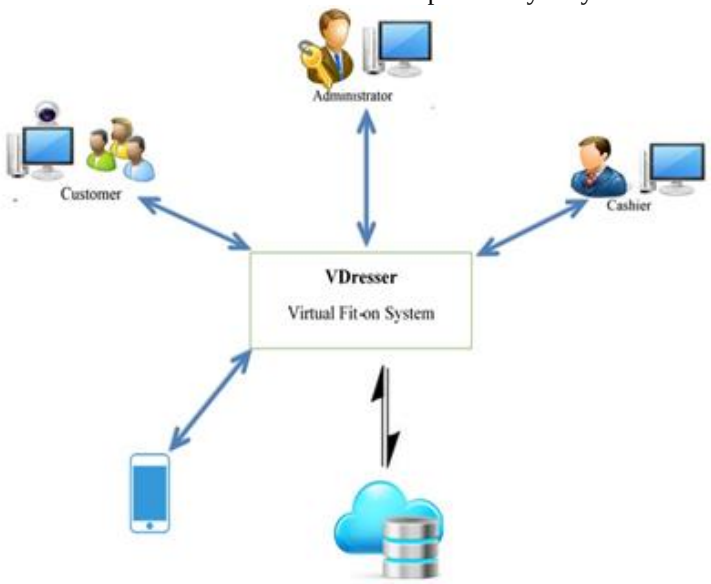

Fig. 2. System Architecture

The performance of VDresser was evaluated by two main aspects, capturing image and fit the cloth. There are three users using this system. They are admin, cahier and customer. Admin has the authority to update clothes, update user details and update stocks through the desktop application. Cashier is doing all the calculations and settle the bills of the customer through the desktop application. Customer is the most valuable person in the system. Customer has to register to select the clothes. He/she can use the system through mobile application and apply the clothes to their body virtually by capturing an image.

D. Implementation

Vdresser was developed as a desktop application and a mobile application with visual studio C# with Microsoft .Net framework 4.0. The face detection, background detection, get the distance, image processing were the main techniques of the VDresser. In image processing used some relevant libraries which support for our product. Ex: - imguCV.

E. Testing

Software testing is very important section of the SDLC. It is a process used to identify the correctness, completeness, and quality of developed computer software and to check whether the actual results match the expected result and to ensure that the software system is defect free before the product is released to the end users.

After implementing the system development team check whether the system works as specified earlier. A test plan was developed and carried out through in the project and it ensures all functional and Design requirements are implemented as specified in the documentation. Testing and evaluation, simply confirms that the product will work as it is supposed. The unit testing, acceptance testing and system testing were applied to the system to check whether the Vdresser system working properly.

- Unit Testing

Unit testing has been done according to the modules we had divided. All the errors and exceptions which occurred in the development have been examined thoroughly. We had tested each and every module separately to check whether they work independently. And also we are tried to decrease number of dependencies and try to test modules isolate. We had spent more time on unit testing as it is more effective than finding errors in latest stages of the development. And also we had written test cases for separate modules by considering the objective, initial state of component, input, expected outcome.

- Integration Testing

After completing the unit testing integration testing had started. Here number of modules tested and not tested for independent modules further. Once after integrating a module, the system must be tested with all the test cases which have been prepared.

- System Testing

Here the team tested the fully integrated application and check how components interact with one another and with the system as a whole and also verified through testing of every input in the application to check for desired outputs. Additionally checked the completed system with the system requirement specification document had completed in the early stages of the developing process.

IV. RESULTS AND DISCUSSION

A. Results

This section covers the results that were achieved from the research project. The team made a questionnaire to fill by customers and fashion store staff. From the answers that were got from, the team took an idea that how the system that would be useful for them.

As an overall result of the questionnaire in figure 03, after implement the system there were 78% users like with the change of the dressing rooms into virtual dressing system.

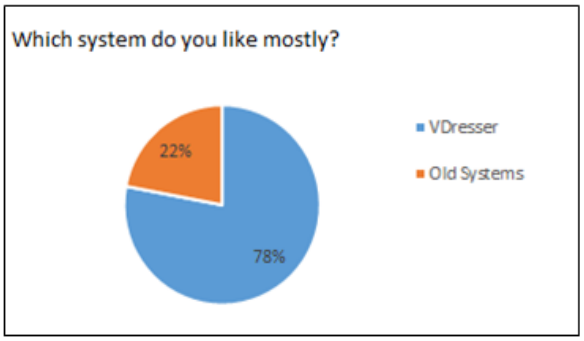

Fig. 3. Overall Result after Implementation

The Vdresser consisted of Desktop, Mobile and Web application. Capturing image part was the main interface of the desktop application.

This is the main interface of the web application. Web application helps users to register to the system. Only the registered user can go through the clothes and select the clothes that fit to their body.

Fig. 4. Customer Registration

Fig. 5. Capture Image

Capture the image of the user from the above interface. If the person went to the correct position the system counts the seconds and capture image automatically.

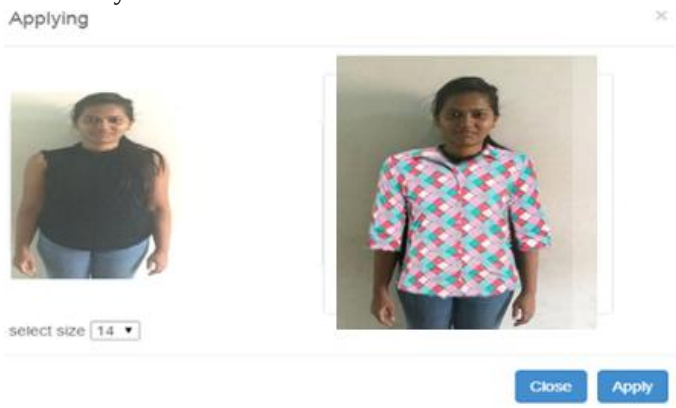

Fig. 6. Apply Cloth

From this interface user can apply the cloth to the body. This interface is the main interface in mobile application. Here the system gave the size automatically. If the user needs to wear the other sizes as well the system gave the opportunity to fit any size of the cloth that were in the system.

Algorithm for Apply cloth to the body

```
public ActionResult ApplyShirt(string imageID,int size)
      {
        try
         {
      Bitmap imgOri =
      new Bitmap(Server.MapPath("~/Content CUSTOMER_IMAGES/" + ((SessionUserModel)
      Session["user"]).ImageURL)     Bitmap imgDress = new Bitmap(Server.MapPath
      ("~/Content/ItemImages/"+ imageID));
        int start = 75;
        int YDress = 0;
         for (int y = start; y < end+75; y++)
         {
        for (int x = 0; x < imgOri.Width; x++)
         {
       Color shartPX = imgDress.GetPixel(x, YDress);
       if ((shirtPX.R >= 0 && shirtPX.R <= 25)  &&
       (shirtPX.G <= 255 && shirtPX.G >=230 )    && (shirtPX.B >= 0 && shirtPX.B <=30))
```

```
  {
     imgOri.SetPixel(x, y, imgOri.GetPixel(x, y))
   }
  else
   {
     YDress++;
     URL = string.Format("../{0}{1}",    "Content/APPLY_SHART/", guid) , JsonRequest
        Behavior.AllowGet);
    }
```

B. Discussion

There are some limitations to overcome in this system. On the detection of the face there are some problem to detect. If the light level of the camera is low and sometimes the face cannot be recognized well. The next problem is detect the person from various background colours. The team were not able to identify person from all background colours. For that purpose the development team selected white colour background. Then only the system can identify person from background.

The team achieved some functionalities of our system like, capture the image automatically. If the person went to the correct position the system counts the seconds and capture image of the person. Sometimes the person was not in the middle of the image. Then also the system can find the person and fit the cloth to the image correctly. There is a position to capture the image by getting the distance. The distance between webcam and the person always the same value.

The system could also solve the sizing problem. It gave the correct size automatically. If the user needs to wear the other sizes as well the system gave the opportunity to fit any size of the cloth that were in the system.

Vdresser is based on desktop application and a mobile application. From the mobile application user can apply clothes to their body while they are walking in the fashion store or in their own house. These kind of functionalities in our system that helps users to find out their best loved clothes with their best loved colours, which might fit them well in a short period of time.

Thirteen test scenarios were carried out and ten of them were successful. So the reliability of the system is 80%.

Rest of the scenarios failed due to following reasons:

- Background noise when capturing the image.
- Bad background lighting when detecting the body.

V. CONCLUSION

Our system presented an efficient and affordable method for real time virtual dress up system. The method consisted of two major steps, capture image and dress up. There existed many benefits from this real time virtual dress up systems for customers, shop owners and companies, such as space saving and reduce wasting cloth tried on. Moreover, it did not require physical space and it was much easier to use. Therefore, system had used an automatic scaling function to resize the input dress images respected to body size lively for blending clothes accurately over subject body. The real time virtual dress up system can be brought into home and used for on-line dress shopping. Current shopping malls mostly used two dimensional figures or oversimplified three dimensional computer-based mannequins and customers were unsure of accurate sizing of dress. This virtual dress up system could solve the sizing problem by having virtual trying on dress instead of physical one. It also made people easier to choose dress perfectly within a short time. Finally, experimental results were demonstrated this proposed method is accurate and reliable to solve the promising and challenging real-time automatic dress up system.

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