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(Project/Thesis Proposal)

Application for the Approval of B.Sc.Engg. Project
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6. Title:

A Virtual Dressing Room based on 2D to 3D body cloning technique

7. Abstract:

A virtual dressing room is the online equivalent of a changing room of an online clothing store – that is, it enables shoppers to try on clothes to check one or more of size, fit or style, but virtually rather than physically. In this project I propose to design a simple application which can easily implemented in online mobile or web application.

Here users only have to upload a set of low cost images of a person taken from four orthogonal views. From these images a recognizable 3D model of the person is reconstructed. Using virtual body measurement system the user is recommended a size to fit from the garments cloths. The user can select preferred size and can try on the cloths from the garments database on the constructed 3D model. User can have the approximate realistic look and feel wearing various dresses from the database.

8. Introduction:

A virtual dressing room (also often referred to as virtual fitting room and virtual changing room although they do, on examination, perform different functions) is the online equivalent of the near-ubiquitous in-store changing room – that is, it enables shoppers to try on clothes to check one or more of size, fit or style, but virtually rather than physically.

Having begun to emerge from 2005, fit technologies started to be widely reported from 2010, but are now available from an increasing variety of providers and are in use by a growing number of prominent retailers in their web stores.

A fit technology may be categorized according to the problem that it resolves (size, fit or styling) or according to the technological approach. There are many different types of technological approach, of which the most established and credible are:

- Size recommendation services
- Body scanners
- 3D solutions
- 3D customer's model
- Fitting room with real 3D simulation
- Dress-up mannequins/mix-and-match
- Photo-accurate virtual fitting room
- Augmented reality
- Real models

My approach to this problem is to create a 3D model of the customer based on a model-based approach is presented for automatic reconstruction of recognizable avatars from a set of low-cost color images of a person taken from four orthogonal views. We give a size recommendation service using virtual body measurement system for tailor made outfits where the system recommends the user which size he should preferred. When the user chose a specific outfit from the store then the cloth is superimposed on the 3D model so that the user can see how it might look on him.

This project aims to develop advanced 3D technology to make a precise and photo realistic Virtual Dress Room at home where you can try the clothes before buying it at the web shop.

Photo realistic appearance and behaviour. Adapt different types of body measurement. True fittings of the virtual cloths.

9. Background and Present State of the Problem:

The following three subsections are focusing on related works.

- Avatar generation
- Generation and simulation of the garments
- Example systems that are comprehended the presented technique

9.1 Avatar Generation

In the field of human body modelling (Avatar Generation), we can classify the existing techniques by dividing into three categories:

- **Sculpting techniques**
    - Sculpting techniques depend entirely on a creative perception of the body.
- **Automatic techniques**
    - Automatic techniques are based on data obtained by different sources
    - Such as scanning, still images and image sequences.
- **Parametric techniques**
    - Parametric techniques use standard parameterizations of the human body and construct new bodies from existing ones using these parameters.

9.2 Garments Simulation

In this context, two types of textile fabrics modelling are distinguished:

- Particles- based models and

- Continuum models

Some are manually designed by the designers some are automatic [17][18] [19]

9.3 Sample Example

Several commercial products exist for VDR implementation.

Styku [1] presents a body scanner that creates a complete 3D model of the user. This 3D model is then used in other web pages to try the clothing items on. The model can be rotated, it can match any size and it even uses a color map to analyze the fit. The body scanning is implemented using Microsoft's Kinect and Asus' Xtion devices.

A VDR implementation by JCPteen [2] gets an image of the user and using adobe flash player displays the clothing items. At the beginning, it shows a shadow on the screen where users have to fit themselves and after that the cloth is displayed. In this system if the user is moving, the item won't follow or track him.

Zugara [3] offers a VDR that is similar to the JCPteens since the items don't move once they are displayed. It is based on the augmented reality concept. The VDR doesn't consider the proportions of the user, only shows how it looks as a fixed template. Similarly, Swivel [4] is labeled as a try-on system that let users to see how clothes and accessories look on them in real-time.

On the Ray-Ban [5] web page, there is a Virtual Mirror where a user can see how the glasses fit on him. If the user turns his head, the model fits the glasses. User only needs to download a plug-in and install it. The program works based on augmented reality: At the beginning the user has to match the face within a shape and position the eyes in a line that it is shown so it takes references of the head. After that it displays the model of glasses that have been chosen.

On the Google Play there is one app for Android mobile de- vices, Divalicious [6], called itself as a virtual dressing room with more than 300 brands. It works by changing the clothes of a default model.

Finally, there is AR-Door [7] which has also has a product based on Microsoft Kinect [8]. With this system, the camera tracks the person's body and a 3D copy of clothing is superimposed on top of the users' image.

10. Objective with specific aims and possible outcomes:

My solution allows the shopper to create a 3D version of him/herself using information taken from several images. Clothes are then displayed on the 3D avatar.

Here are some possible outcomes that will be further illustrated:

- Easy to implement on small devices like mobile phones and computers.
- Cost efficient because any expensive hardware need not to be used.
- More time consuming, user doesn't have to go to the store to try on the outfit physically.
- Constructed avatar can be used in other applications like games and augmented reality.

11. Outline of Methodology:

The methodology is divided into two parts:

- **Photo-cloned body with acceptable level of accuracy**
- **Online cloth fitting and simulation**

11.1 Face & Body cloning from images:

The main idea to get an individualized head, is to detect feature points (eyes, nose, lips, and so on) on the two images and then obtain the 3D position of the feature points to modify a generic head using a geometrical deformation. The feature detection is processed in a semi-automatic way. The user sets a very few feature points (key points) and the other feature points are fitted using a piecewise affine transformation first and then snake methods. The structure snake method with some anchor functionality. Then, two 2D position coordinates in the front and side views, which are the XY and the ZY planes, are combined to be a 3D point. After using a global transformation to move the 3D feature points to the space for a generic head, Dirichlet Free Form Deformations (DFFD) [23] are used to get new geometrical coordinates of a generic head adapting to the detected feature points. The control points for the DFFD are feature points detected from the images. Then the shapes of the eyes and teeth are separately adapted to the new head with translation and scaling from the generic model. Figure 11.1 shows the steps for head modification from photos.

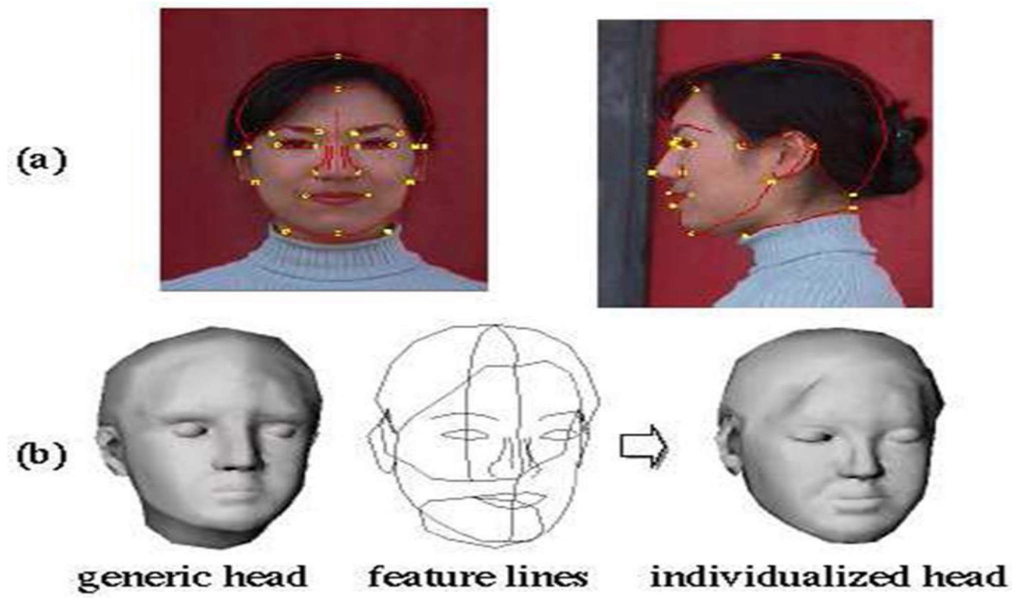

Figure 11.1: (a) normalization and features. (b) Modification of a generic head with feature points

11.2 Body Cloning:

- Model based method
- This approach combines a generic face template and an H-Anim1.1 compliant body model
- Feature points extracted from the three orthogonal images and a parametric approach is taken according to Anthropometry [16][3]

Our body cloning is a model-based method. We use two main inputs. The first input is the generic body. The second is still photos of a person to be cloned. We assume the person wears trousers and not too loose clothes. We deform the generic body to adapt to the individualized body.

11.3 Generic body structure

The generic body is in MPEG-4 compatible H-Anim 1.1 formats [9]. The skeleton and several skin parts displayed with several colors are shown in Figure 5 where the skin parts are smoothly connected. It has 94 skeleton joints and 15 skin parts including head, right_hand, left_hand, right_foot and left_foot.

11.4 Feature Extraction:

We input the height of the person and the image body heights are checked on the three images for normalization. Figure 11.2 shows normalized images. Since we use arbitrary background to take photos and the size of the person is not fixed, we use interactive feature points localization on images as shown as small points in Figure 11.2.This simple feature points localization is used for skeleton modification, rough skin deformation and automatic edge detection in the next sections.

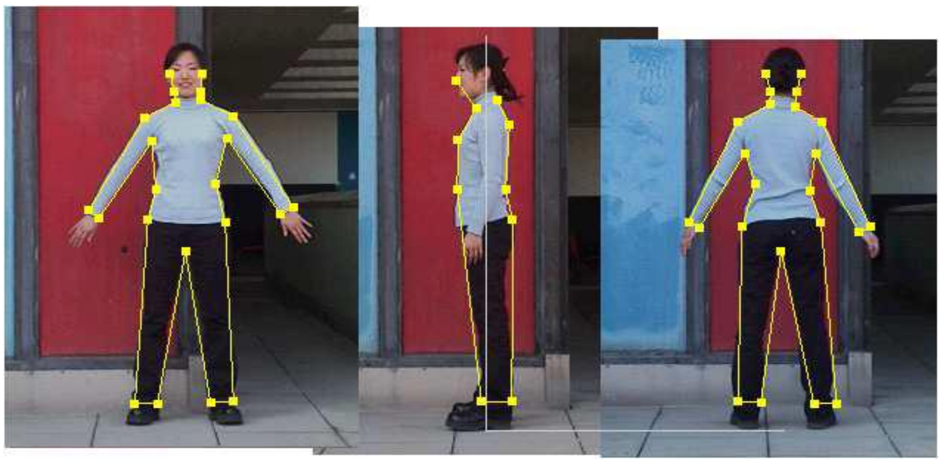

Figure 11.2 Feature points on three images

11.5 Skeleton Modification:

Figure 11.3: Automatic Skeleton fitting with feature points.

When we have feature points for the skin envelope (even though the person put on clothes, we assume that the clothes outlines are close to the skin outlines), we can have an estimation of the skeleton. For example, for the r_elbow must be located around middle position between the right end shoulder point and outer end point of the right wrist. Here we apply affine transformations and Barycentric interpolation to find the typical skeleton joints from feature points. Since there are 94 skeleton joints, we make a subset of joints as key joints, which are modified by feature points while others are modified by piecewise affine transformations defined by key joints and the skeleton hierarchy. The skeleton joints of the head, hands and feet are simply scaled and translated with the transformation between the generic body's skeleton and the person's skeleton, for example vt1 and HumanoidRoot can be used to find the transformation. Figure 11.3 shows the skeleton modified by the front and the side views. Since the front and back views do not have the exactly same pose, the skeleton modified by the front view does not match on the back view.

11.6 Face & Body Cloning Outline:

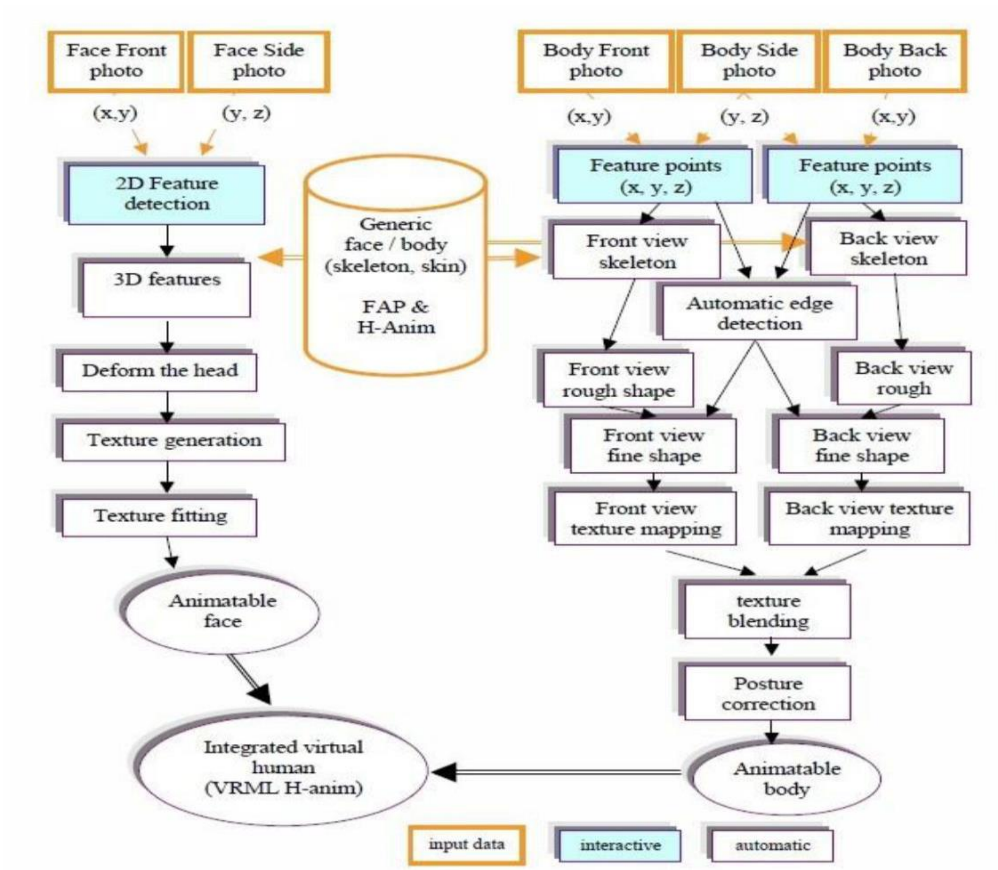

Figure 11.4: face & body creation outline [3][5]

11.7 Body creation based on measurement:

Our body cloning is a model-based method. We use two main inputs.

- generic body
- still photos of a person to be cloned

Cloning divided into following steps:

- Generic body structure
- Taking photographs and initialization
- Rough skin modification
- Heuristic based silhouette extraction
- Fine skin modification with silhouette information

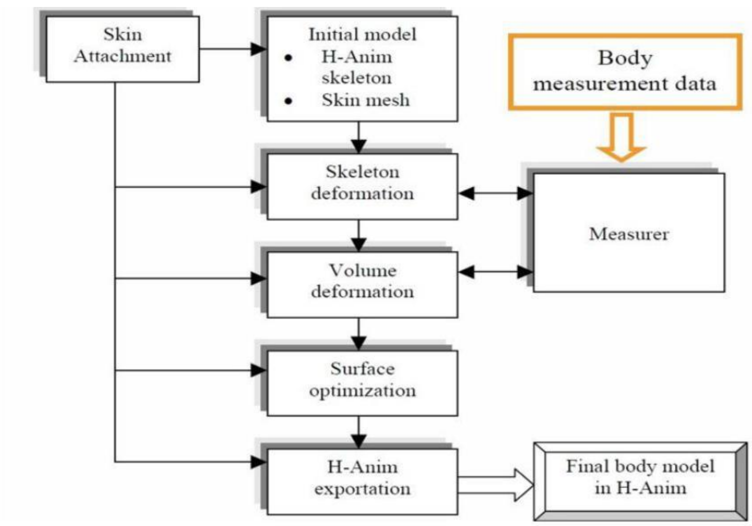

Figure 11.5 shows the Body creation based on measurement [3]

11.8 Cloth Fitting and simulation:

Cordier and Magnenat-Thalmann (2002(a) and (b)) described a complete system that can display real-time animations of dressed characters. It is based on a hybrid approach where the cloth is segmented into various sections where different algorithms are applied.

- The skin surface itself. An offset on the skin mesh possibly models cloth thickness. These garment parts directly follow the motion of the body without any extra impact on the processing time.

- Loose cloth which remains within a certain distance around the body (sleeves, pants) are simulated by mapping the cloth mesh into a simple simplified particle system where the particles are constrained to move freely within a sphere of varying attached to the original skin position. The particles remain independent and only subject to constant gravity forces, which allows the simple computation of a very simple and fast explicit parabolic motion curve for them. This is, however, enough to reproduce some realistic dynamical motion as the body moves. They are constrained to remain inside their respective spheres using a simple geometrical projection on their position and speed. The radius of the sphere is dynamically computed according to the desired cloth looseness and the current angle of the corresponding skin surface relative to gravity minus skin surface acceleration direction, so as to roughly model a catenary curve.
- Loose cloth which is not specifically related to a body part (skirts) are computed using a very simple mass-spring system following the triangle mesh structure integrated with the implicit Euler method, using the techniques described in (Volino and Magnenat-Thalmann 2000(b)). This layer, which requires the implementation of a numerical integration scheme, is the heaviest in terms of computation. Collisions with the body are processed by enclosing body parts into bounding cylinders animated by the body skeleton and applying simple projections of particle position and speed on the cylinder surface in case of contact.
- This scheme, which cannot model accurately contacts, is, however, robust enough to prevent flying cloth entering the body. Pre-processing determines the potential colliding particles for each cylinder, limiting computation

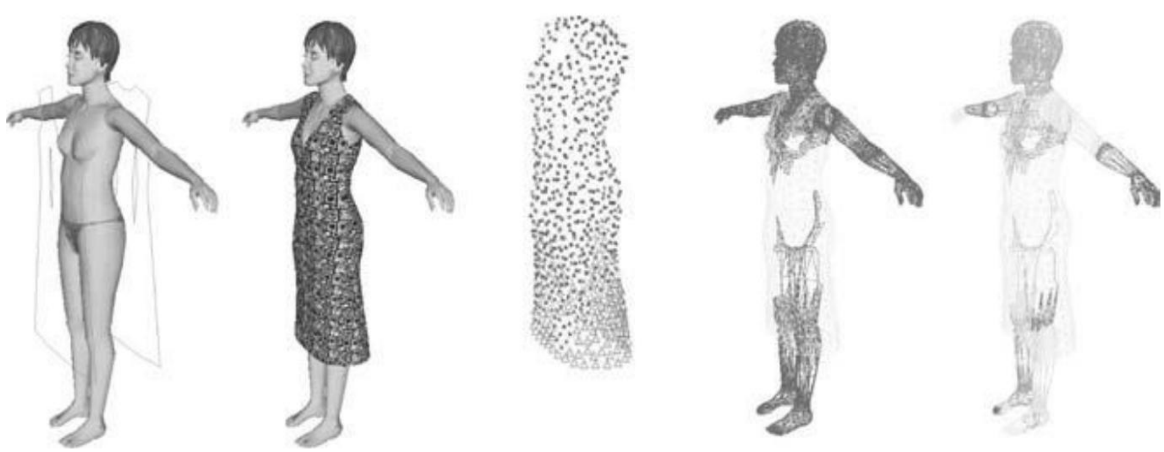

Figure 11.6: Building a real-time garment: designing and assembling a garment with traditional methods, isolating garment regions for simulation contexts, removing invisible skin regions, attaching cloth to the body animation

12. Conclusion :

We have developed a methodology to see ourselves at any angle in privacy and try several different styles of garments. We have introduced this idea for Made-to-measure garment simulation on an individualized body using an online web application. The key points we have shown here are the acquisition of personal virtual body from easy input such as photographs or measurement, the 3D-garment made to exact measurements calculated from 3D virtual cloned body or measurement-oriented body, and then the optimized Made-to-measure garment simulation on the web. Finally, the 2D patterns are generated from the personally sized garments. These 2D measurements could be directly sent to the cloth manufactures. The speed optimization for on-line calculation comes from wide use of generic database of bodies and garments. This research works as a prototype. To have it working on daily basis, it needs to optimize every step.

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[14] Lingyan Jiang1,3, Jian Yao2,1*, Baopu Li3, Fei Fang1, Qi Zhang3, Max Q.-H. Meng4,3 Automatic Body Feature Extraction from Front and Side Images School of Computer, Electronics and Information, Guangxi University, Nanning, Guangxi, P.R. China; School of Remote Sensing and Information Engineering, Wuhan University, Wuhan, Hubei, P.R. China; Shenzhen Institutes of Advanced Technology, Chinese

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14. CSE Undergraduate Studies Committee Reference:

Meeting No.: **Resolution No.:** **Date:**

15. Number of Undergraduate Student Working with the Supervisor at Present:

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Signature of the Student **Signature of the Supervisor**

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Signature of the Head of the Department