Generating Accurate 3D Models of Body and Clothes for Photorealistic Visualizations and Animation

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***Abstract*— The paper presents the new approach to generating 3D models for photorealistic visualisations and animation of person silhouettes and clothes. A group of over 150 people were involved in the research and dozens of clothes were used as basis. Implemented virtual models have been compared with real objects in order to demonstrate that high quality of generic reconstruction can be achieved even for varied input data.**

I. INTRODUCTION

To achieve photo-realistic visualization and animation of woman wearing the dress the two things are needed. First is the accurate avatar generator which takes measurements as an input and generates 3d rigged model which later can be used as a base for realistic motion capture animation. Second one is accurate 3d model of the dress which dimensions correspond to the real dimensions of the clothes. Mixing these two together we can achieve realistic visualization of moving woman wearing the dress.

II. GENERATING AN EXACT BODY MODEL

We generate very accurate approximation of human body. We put a few parameters that user provides(breast girth, hip girth, waist girth, total height and weight in kilograms) into fuzzy logic algorithm that firstly interpolates input parameters and fits them between known 3d models(see the testing session section) and known parameters. After that it extrapolates into larger number of parameters. These parameters directly controls the blend shapes that drives the human 3d model.

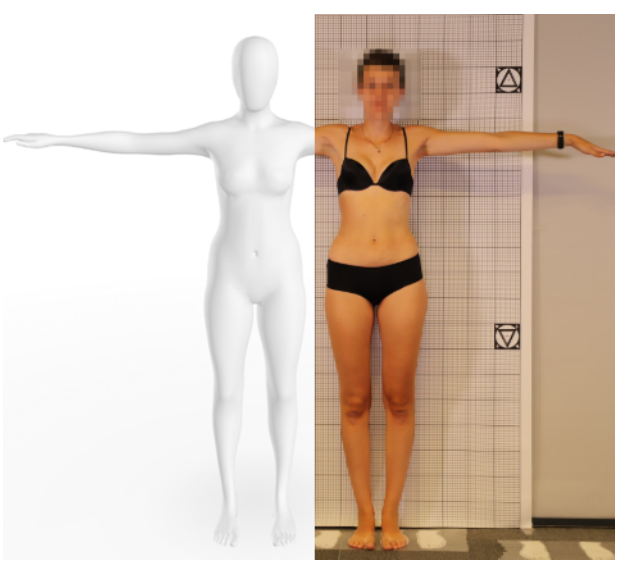

Fig. 1. Side by side view of generated 3d avatar and real person

III. GENERATING AN EXACT CLOTHES MODEL

We are using automatic 2d pattern generation from the photo. All we need as input is single photo from high resolution camera. We use additional shape(currently 10x10cm square) to detect the scale and perspective. Our algorithm corrects the perspective and extract the clothes parts as DXF format. From 2d patterns we generate 3d clothes which are simulated over the animated human model.

Fig. 2. Comparison of the real length of 2d pattern and the recreated one from the automatic digitiser from photos

The table below presents the comparison between real lengths and the digitized length which is used in creating 3D garment. The average error is 0,68%

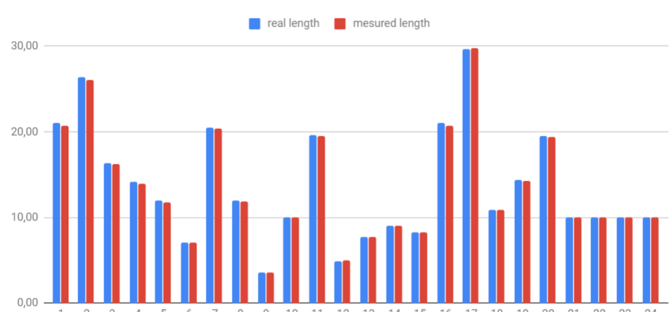

Fig. 3. Comparison of the real dress and recreated in the virtual scene

IV. TESTING SESSION

The aim of the testing session was to collect and develop visual data for a representative sample of people. Based on dynamic data recorded in the motion capture technology, moving models typical of the highlighted persons and motion animation of the generated 3D model with the most similar silhouette for realistic character and clothing animation were prepared.

In the first stage, basic information about people body was collected based on individual surveys. The respondents initially declared their height, weight, body type and size of clothing worn. Based on this data, the test group was selected to account for characteristic silhouettes. A total of over 150 people participated in this part of study, of which 50 models were selected for further tests.

In the next stage, the dimensions of persons were verified indirectly. Then the image of each person was recorded in selected body positions, e.g. T-Pose, A-Pose, II-Pose, from various sides, in order to compare models of people and real silhouettes. After taking photos, the model was also recorded in the selected clothes.

A. Accuracy of the Body Model

As part of the verification of the correctness of generating body model, a comparison of key dimensions for persons and their obtained 3D models was made. Following set of parameters of the silhouette were taken into consideration: height and circumference of bust, waist, hips and thighs. A relative error was calculated from each pair of above parameters.

The accuracy results for examined 50 real persons, in ascending order of their size, are presented in Figure X. The averaged relative error is 0.90% for bust, 0.43% for thigh and 0.17%, 0.16% and 0.13% for hips, height and waist, respectively. The averaged inaccuracy of the generating the body model does not exceed 1%, which is acceptable. In addition, there can be observed very slight declining trends along with increase in body size.

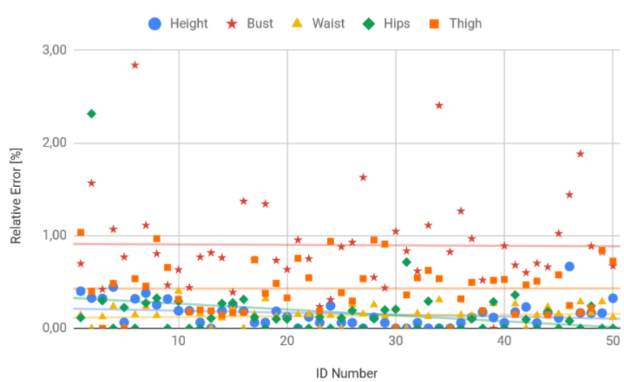

Fig. 4. Corresponding errors of the generated 3D model to the real measurements

B. Accuracy of the Clothes Model

In order to verify the correctness and determine limitations of the developed method of generating clothes model, a comparison of real and calculated graded parameters was made for selected real copies of dresses. The worst-case scenario was adopted, i.e. the original clothes design was being reproduced, which was unknown. Test was based on a set of selected irregular sizes (S to XL) and XS specimen was used for verification, since highest relative errors were expected for the latter. In addition, the tested dresses were made of a stretch fabric.

The choice of clothes parameters has been made to take into account the characteristics of a given pattern of clothes, including the availability of a given parameter and the convenience of measurement to minimize possible measurement errors. There were selected circumferences of waist and bust as well as vertical height: neck to waist and waist to bottom.

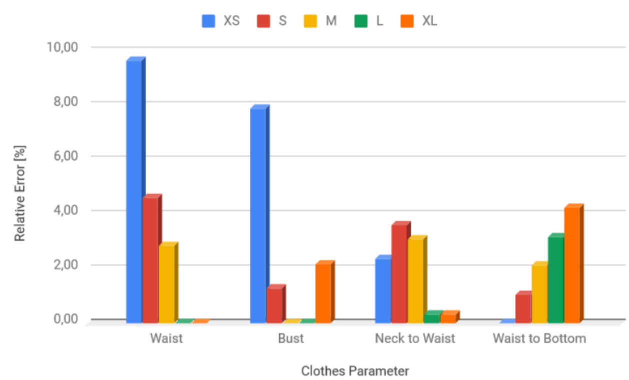

Fig. 5. Errors of automatic grading - extrapolating from one size to the others

In this worst-case test, the average relative error calculated from all parameters of reconstructed dresses was 2.44%, which is acceptable. However, in a few cases the error turned out to be higher, which requires a comment.

In all cases, the error is mainly due to differences in the clothes grading and accuracy tolerance adopted by the manufacturer. Clothes are also processed at the production stage, which is an important factor in the product parameter inaccuracy, in relation to the original design. To a small extent (about 0.5 cm) inaccuracies result from errors in the measurement of the dimensions of real copies.

The lack of a XS size in the input data set was of key importance for the accuracy of the mapping in the examined case, especially as the manufacturer's dimensions and grading deviate non-linearly from the typical parameters. Finally, the accepted approach to the reconstruction of the original clothing design was also important.

It can therefore be concluded that clothes reconstruction accuracy varies depending on assumptions and available data. It is advisable to verify all sizes and many corresponding physical copies, which will guarantee the reduction of inaccuracies to measurement errors, that is ending below 3%.

V. CONCLUSIONS

We have presented results of generating virtual 3d models. The achieved accuracy is at good level compared to verified real objects. Averaged errors are lower than 3% both for the reconstructed body models and the graded clothes. In addition, we have identified limiting factors for digitization. In future work we will experiment with different clothes patterns, types of figure and advanced processing algorithms.

Research is performed by WearFits (wearfits.com) - virtual fitting room creating a new quality of visualization and sale of clothing in e-commerce, with co-financing of the European Regional Development Fund.