Similarity based Retrieval from a 3D Human Database

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ABSTRACT

In this paper, we describe a framework for similarity based retrieval from a 3D human database. Our technique is based on both body and head shape representation and retrieval based on similarity of both of them. The 3D human database used in our study is the CAESAR [CAESAR] anthropometric database and in it are around 5000 bodies. Furthermore, we have developed a web based interface for specifying the queries and to interact with the retrieval system. We have seen that our approach performs the similarity based retrieval in a reasonable amount of time and seems to be a practical approach.

Keywords

Human database, retrieval, similarity, body and head shape

1. Introduction

With the wide availability of 3D scanning technologies, 3D geometry is becoming an important type of media. Searching a database of 3D objects which are similar to a given 3D object is an important problem. The whole practice is also called query by example (QBE). We have developed techniques for searching a human database and have used the CAESAR anthropometric database, where they have scanned around 5000 humans to create a 3D human database. In our study we have implemented methods for similarity based retrieval from CAESAR human database based on both human body and head shape. Previous work on human body retrieval based on body shape was performed by [Paquet and Rioux 2003] and retrieval based on head shape was performed by [Ip and Wong 2002].

2. Body Shape Descriptor

The two methods based on human body shape are:

2.1 Distance Based

The first method uses a descriptor vector **d** based on lengths mostly between single large bones. Thus, we form a 3D body description vector of fifteen distances, d, with d_1 wrist to elbow, d_2, elbow to shoulder, d_3 hip to knee etc. for which the Euclidean distance $\mathbf{d} = ||P_i - P_j||$ is invariant across different poses. Distances such as chin-knee are avoided. This method is both pose and orientation invariant.

2.2 Silhouette Fourier Based

The second method is based on rendering the human body from the front, side and top directions and creating three silhouettes of the human body. The theory is that 3D models are similar if they also look similar from at-least these three viewing angles. These three silhouettes are then encoded as Fourier descriptors as features for later similarity based retrieval. This method is pose dependent.

3. Head Shape Descriptor

The two methods based on human head shape are:

3.1 PCA Based

In our method we neglected the effect of facial expression. We properly positioned and aligned the facial surface and then interpolated the surface information on a regular rectangular grid whose size is proportional to the distance between the landmark points. Next we perform Principal Component Analysis (PCA) on the 3D surface and similarity based descriptors are created. In this method the head descriptor is only based on the facial region.

3.2 Spherical Harmonics Based

In the second method the 3D triangular grid of the head is transformed to a spherical coordinate system by a least square approach and expanded in the basis of spherical harmonic representation. This method had convergence problems for 20% of the heads.

4. Results

From the web based interface we can select a particular body, or a random body, or bodies based on some criteria, such as weight, age, height, etc. Then we can perform similarity based retrieval based on a single descriptor out of the four descriptors. The reason for these four descriptors is to select the best descriptor for your application, such as the use of head descriptor for helmet design. The partial results from a body shape based similarity retrieval for subject no 16270 are shown Figure 1. The initial results show that the results and amount of time for retrieval are very reasonable. In the future we plan to use the body and head shape descriptor for clustering human bodies.

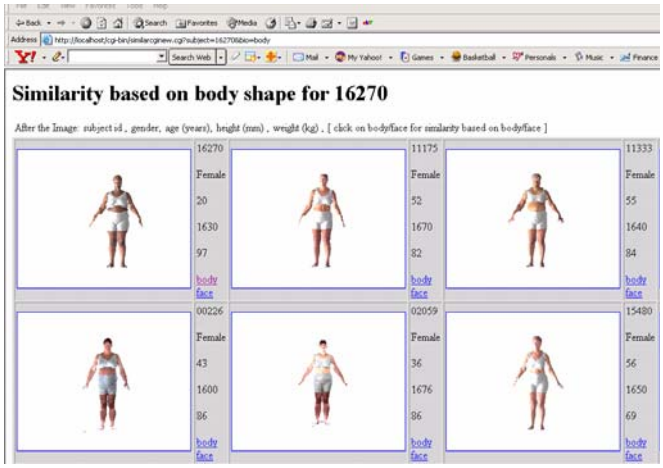

Figure 1, Shows a body shape based similarity results

References

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