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The virtual face modeling method based on user facial recognition and Unreal Engine 5 MetaHuman Creator

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Abstract. The face model based on the real face is a technique with hugely increased demands in recent years, The methods for the modelling are still in an early stage and only used in research and business fields. As the increased demands, areas other than business and research will require this technique. However, the cost of professional modelling is unaffordable for individual users. Therefore, through theoretical analysis and a literature review, this paper illustrates the possibility of combining face recognition technology with Metahuman Creator for face modeling so as to achieve the goal of reducing the cost of face scanning and popularizing it among individual users.

Keywords: facial recognition, Unreal Engine, MetaHuman Creator, virtual face modeling.

1. Introduction

Today's technology is experiencing huge innovations every day, and the whole of society is immersed in such a technological revolution. Metaverse is a novel concept that attracted much attention these years, and gradually becomes the future trend of development of cyberspace. In the metaverse, each user is allowed to have a virtual figure called Avatar, and the rule of metaverse is to allow the avatars to seamlessly travel from virtual worlds on a cyber web [1]. The metaverse has applications in several fields, including medicine, education, game experiences, etc. All metaverse applications have a core concept of Avatar of Users, which asks each user to have their unique virtual figure. One of the methods of creating a unique avatar is to copy the user's face data in the real world and directly model it and input it into the virtual world.

The traditional way of modeling faces based on real personal facial data is by 3D Scanner [2-4]. However, the weakness of such method is the necessity to be on-site, and the cost is relatively high. To solve this problem, it is necessary to find a way with low cost and high accessibility.

Facial recognition technology is quite mature in development, and is based on artificial intelligence analysis rather than highly precise hardware scanning, which allows it to be set on most HD cameras and be accessed by most users with their own equipment. Therefore, with nearly mature face recognition techniques and metahuman creators made by Epic Games based on Unreal Engine 5, a straightforward approach to face modeling could be designed [5]. In general, face recognition is to build a series of processes to convert people's faces to data that a computer can evaluate and make judgments with existing face data through deep learning [6].

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This article would review the technology of facial recognition and Metahuman Creator, and illustrate the possibility of the method of facial modeling by combining these two techniques. With such a combination, personal users could also access the private face modeling process, and get a personalized virtual model. Also, the result derived in this method might not meet the highest requirement of accuracy in certain cases, but with the development of modelling process, the accuracy could be gradually increased.

2. The development of face recognition

Since the 1950s, the concept of face recognition has appeared, but restricted by the ability of camera analytics and computer algorithms, it did not really under development until 1964, and did not been applied to any cases in practice. In 1964, Bledsoe imagined a geometric method to accomplish face recognition [7].

In 1991, Pentland and Turk created the first successful face recognition example named Eiganfaces by the method of Principle component analysis (PCA), which is the most popular algorithm of face recognition for a long period [8].

In 1995, the face recognition technique stepped into the stage of artificial features and classifiers [6]. the Support Vector Machine method was proposed by Vapnik and Cortes [9]. This method solved the PCA's problem of requirement for a large sample, and allow the higher dimensional analytic.

Today's face recognition algorithms are mainly based on Deep Learning, which is a kind of machine learning method and has the ability to auto find out the needed feature in the process of training. In the research of face recognition based on Deep learning, Convolutional Neural Networks accomplished the most influential success [10].

3. The basic operation logic of face recognition

Today's face recognition technology is mostly based on machine learning programs. General machine learning includes the data input, training method, and test data. The data is divided into features (the elements that will influence the output) and labels (the data that match the correct answer of input features), and the program will use the features and training method function to match the labels and refine the method.

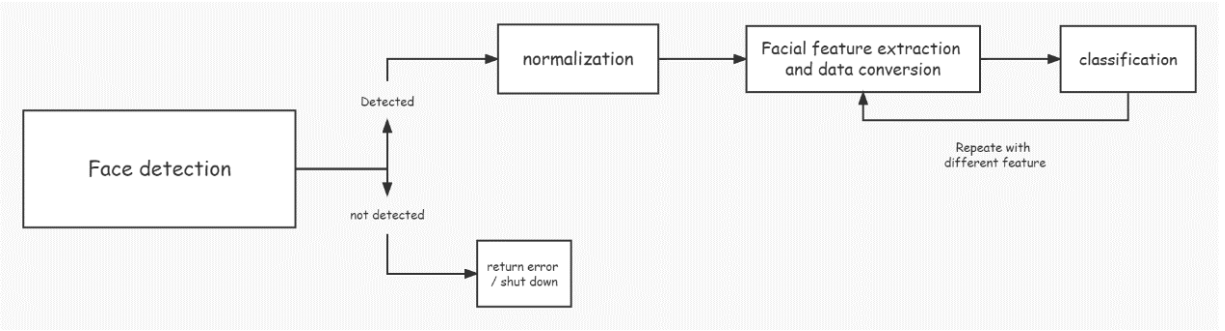

Figure 1. the process of Face detection in normal facial recognition program.

Similarly, face recognition algorithms has three main steps: 1) face detection and general normalization; 2) feature extraction and accurate face normalization; and 3) classification with an existing dataset [11].

During the face detection phase, the program will determine whether there is a recognized face in the image, and if does, the program will then locate the position information of the face that will be recognized. Then extract the feature of the face, and convert it into a data form. The feature extracted must be specified and unique that could represent the face, and separate from other faces. In the classification process, the data converted in step 2 would be checked and compared with other face data stored in the database. The program would check the input data with several sets of labels to ensure the possibility of error is reduced as far as possible (Figure 1).

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4. Method

4.1. Metahuman Creator (MC)

Unreal Engine by Epic Games is the most open and advanced 3D real-time creation tool, which allows content creators and game developers to realize the next generation of real-time 3D content with a great degree of freedom, fidelity, and flexibility.

In 2021, accompanied by the release of Unreal Engine 5, Epic Games also released a Cloud stream based human body modeling software named Metahuman Creator [12]. Metahuman Creator is an open accessed complete framework that allows any content creator to have the power to create highly realistic human characters in the virtual environment.

The traditional way of modeling the human face is based on locating geometric 3D coordinates of the face features in a stereo-pair of images or video sequences to construct the face model [13]. This method is based on a restricted number of image frames and hence the 3D coordinates of the front head and cheeks cannot match properly to the landmarks in a series of 2D images. Therefore, most modeling by such a method could only derive a model with low resolution.

Metahuman Creator software is based on the prestored real face scan database, which guaranteed the users to create realistic human body and face model frameworks. In addition, the details on the face model could be freely adjusted: the creator could freely choose the hairstyle and color, the facial makeup, and skin tone. Moreover, Metahuman Creator has a strong connection with Unreal Engine 5, and the modeling in the Metahuman Creator could be freely used in any real-time virtual environments created by UE5, and could be easily processed by high-end PC with RTX Graphic cards, Xbox, PS5, and Android. The body model in MC has the preset facial expression and body action animation, which allow them to be directly used in dynamic scenes with high flexibility.

The operation logic of MC is kind of different from traditional body modeling software, such as 3DMAX and C4D modeling. MC provides hundreds of facial presets, and the user could use three main tools to edit the preset model: 1) blending tool (Figure2), which allows combining more than one preset face into a face model and the users could drag the portrait to adjust how many trait of each preset will be kept in the combined model; 2) move tool, which allows the user to move some parts of the face along the guidelines; 3) sculpt tool, which allows the user to pull and push the control points on the face.

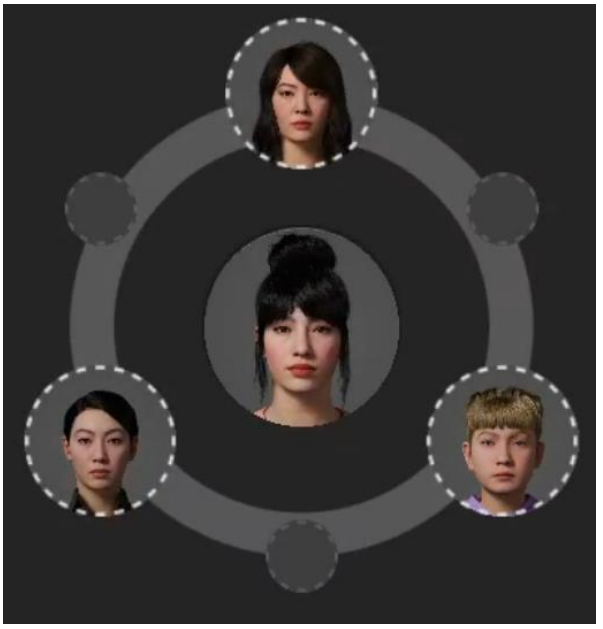

Figure 2. the blend function of MC.

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4.2. The conjecture of the modeling method of combining face recognition algorithms and Metahuman Creator

Due to the different operation logic, Metahuman Creator has the possibility to be connected with simple face recognition algorithms and create a general human face model in an efficient way.

Since the Metahuman Creator has several resources of preset face modeling data, and each of them is prepared to be converted into precise data form, those presets could be simply used as input for the database for the face recognition modeling program. In the execution of the program, after the face is detected, the face features would be converted into data form, and then derive a global facial model that contains the 3D data of the users' head shape and the location of the sense organs by setting the coordinate landmarks. Next, the program will be asked to check throughout the preset databases, find out four global head models with the least data error with the data input, blend them to reconstruct the new face model which matches the global feature, and use it as the framework of global head modeling.

However, after deriving the global deformation model, the similarity between the model and the real face cannot match the standard. Therefore, local optimization is necessary. In MC, there are 14 landmarks on the face model that allow the blending function, and more than 30 locations that allow sculpting. The second step is to process the local analysis, extract the local feature of the image, use the move tool to adjust the location of landmarks on the model, and use the sculpt tool to adjust the geometric shape until the difference between the original image and the face model is controlled at a threshold [Figure 3].

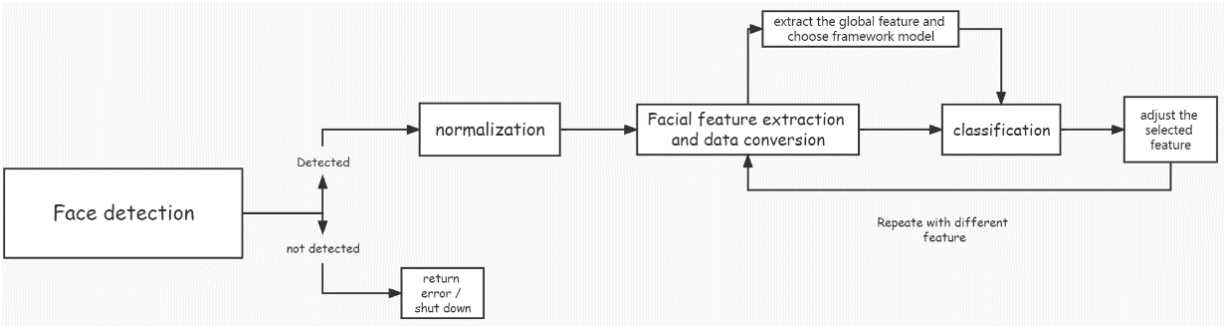

Figure 3. Developed face detection process that allows automatically modelling.

After that, the user could get their head model data, and still can edit it freely in MC. The final customize steps are designed to be done by users themselves. They have the access to alter their hairstyles, skin tones, and adjust the model completed by the program in their liked ways.

The final model could be easily added to UE5 animation and CG production, and more customized material packs are available on the Internet, the user could further customize their model by adding those packs.

5. Conclusion

This article provided a general review of the development of face recognition technology. The recent advance in this field, especially the method based on Deep Learning and artificial intelligence, are clearly stated. The face recognition technique now could be used in several social cases, including, but not only on, business, security, and science research. It now can be used in both public and private equipment and more people could get access to this new technology. Moreover, this article introduced the next-generation animation and modeling engine Unreal Engine 5 and the publicly accessed body modeling software Metahuman Creator, which allows normal people could create their unique virtual figures in an easily accessible way. Along with the development of virtual networks and identity, the modeling creation that could be accessed by the public is going to attract more attention from the researchers and developers, thus the conjecture of a simple way of generating private customized unique face modeling is raised. However, this method is still in the stage of conjecture, and further research

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should be done. The barrier of whether private equipment could generate data for a near 100% precision head modeling is the most significant point that should be focused on.

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