

Application and Development Trend of Computer Science in Face Completion

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Abstract: In recent years, with the development of computer vision technology and the arrival of the covid-19 epidemic in daily life, the demand for occluded face recognition is increasing rapidly, and the demand for face completion technology in actual production and living scenes is growing rapidly too. However, there are still some problems in face completion technology, such as complex procedures, large amount of computation, long time required, and fuzzy details. Therefore, this paper reviews the development process of face completion technology, briefly describes the basic principle and defects of face completion technology, and summarizes the problems existing in the existing computer-based face repair technology, such as large amount of computation, long training time, blurred image details, and inaccurate pain points in the occlusion layer, and prospects the future development. These problems can be improved by optimizing algorithm, adopting new algorithm, adding new network and adding image preprocessing stage.

Keywords: Face Completion; Deep Learning; Generative Adversarial Networks.

1. Introduction

With the rapid development of computer vision technology and artificial intelligence technology, face recognition technology has become mature and can be widely used in daily life such as security, medical care, education and financial transactions. However, in practical application scenarios, it is difficult to obtain clear and unshielded face images due to the influence of people's daily wear and sensor equipment shooting angle. Especially since the outbreak of the covid-19 virus, people always tend to wear masks in daily life. Nevertheless, during the process of face recognition, people have to removed masks that they wear, which obviously increases the risk of new coronavirus infection. Therefore, face completion technology came into being. The application of face restoration technology to restore the face for computer recognition will greatly improve the recognition rate and robustness. At the same time, since the recognition object does not need to remove the mask, it will greatly reduce the risk of people being infected by virus.

2. Development of Face Completion Technology

With the development of computer vision technology, face recognition technology has been widely used in various occasions in daily life. However, in the practical application process, it is often difficult to obtain clear and unshielded face images. Therefore, by restoring the incomplete face image to a complete and clear face image for computer recognition, the recognition rate and robustness will be improved, and it has a high application prospect. The emergence of deep learning technology has greatly improved the accuracy and speed of face image restoration. Therefore, this paper takes the emergence of deep learning technology as a vital symbol of the development process of face repair technology.

2.1. Previous Deep Learning Period

In the early 21st century, deep learning technology has not

yet appeared. At this time, the main research direction of academia is the subspace regression method. By extracting the feature vector of face image to high-dimensional space, the vector is segmented in high-dimensional space, and then repaired and recognized. This method has achieved great success at first, and has a high success rate for small area occlusion and fouling. When the sample size is sufficient and the time is long, the recognition rate can reach nearly 100 %. However, when face images are occluded in large areas, the recognition rate will be greatly reduced. In the exploration of the previous deep learning period, although the number of programs that can be applied in practice is small, it provides key ideas such as extracting feature vectors for the face restoration technology based on deep learning.

2.2. Deep Learning Period

After 2010, with the blowout of deep learning technology, especially the vigorous development of neural network system, scientists have seen the prospect of applying deep learning technology to face completion. Subsequently, the exploration of face image restoration using generative adversarial network, FaceNet and other technologies has emerged. Deep learning technology for face completion has the advantages of high recognition rate and accurate repair. Combined with convolutional neural network, it can effectively identify face photos with occlusion. For example, for face recognition of people wearing masks, occlusion face images can be repaired by generative adversarial networks, and then the repaired images can be output to convolutional neural network for recognition.

3. Basic Principle of Face Completion Technology

At present, the mainstream computer repair technologies for face images are generative confrontation network (GAN) and context encoder (CA). Among them, after iterative training of a large number of training sets, the generative confrontation network has high repair rate and repair accuracy,

which is the most popular research direction at present.

3.1. Context Encoder

Context encoder is composed of encoder and decoder, similar to generative adversarial network. The difference is that the decoder is a deconvolution network. The incomplete face image is input into the encoder, convolution it, and then the obtained data is input into the decoder. The decoder outputs the reconstructed image by transpose convolution.

3.2. Generative Confrontation Network

The generative confrontation network is proposed by Ian Goodfellow and Yoshua Bengio in 2014 by two neural networks. One neural network repairs the face image based on the incomplete image, and the other neural network judges the accuracy of the repaired image.

3.2.1. Basic Structure of Generative Adversarial Networks

The generative confrontation network is composed of two neural networks, namely, the generative network and the discriminant network. Generate the network to accept the incomplete face image as input, according to the characteristics of the input face image, output the repaired face image. The repaired face image is input into the discriminant network, and the discriminant network also gives the probability that the image is generated from the real sample set rather than the generated network according to the characteristics of the face image. If the generated network is good enough, the discriminant network cannot judge whether the input image comes from the real sample set or the generated network, and the probability of output is 0.5. At this time, this generative confrontation network can meet the technical requirements of face image restoration technology.

3.2.2. Training Process of Generative Confrontation Network

The training process of generative adversarial network is mainly to train the two networks in an adversarial way, so as to continuously optimize the two networks and achieve the effect of the optimal model. The incomplete face image is input into the generation network. The generation network locates the incomplete area by function operation. In the training of a large number of training sets, the accuracy of positioning is continuously improved by alternating optimization technology. After locating the defect area, the corresponding complete area will be generated and fused with the original defect area to generate the repaired image and input to the discriminant network [3,4]. After judging the network received input, it will be compared with the image of the sample set, and the probability of the image from the real sample set is given. After multiple iterations, the texture details of the output image will become richer and richer, close to the real image.

4. Short Board and Development Trend of Face Completion Technology

At present, the face repair technology based on generative adversarial network has the advantages of high repair rate and high repair accuracy, and there are many related trained models published. The context encoder is very similar to the generative adversarial network in principle and structure. Therefore, both shortcomings are common. Face restoration technology based on generative adversarial network still has

some defects to be improved. Next, the shortcomings of face restoration technology based on generative adversarial network are briefly described.

4.1. Heavy Computation

Because the repair process and training process of the generative adversarial network are related to the convolution operation of the two sets of neural networks, the requirements for computer performance are relatively high. Therefore, the hardware requirements for running the generative adversarial network are high, which makes the training and use of a set of available generative adversarial network for repairing face photos expensive and not conducive to wide use.

4.2. Long Training Time

Since the neural network needs a large number of data for training, the generative adversarial network also needs a large number of samples sets for training, such as the data set containing one thousand and more pictures. If the training sample is less and the training iteration time is less, the accuracy of the repaired image will decrease sharply.

4.3. Image Details Blurred

When the generative adversarial network outputs images, due to the lack of sufficient information, the restoration of the occluded part still has the problems of fuzzy details and distortion to a certain extent with the original image. Although the output image quality is enough to discriminate the network for face recognition, there are still some differences with the actual image.

4.4. Positioning Occlusion Layer Not Accurate

There is a problem of inaccurate positioning of mask layer in face image processing by generating network. This increases the difficulty of generating network to restore face images, which is easy to cause image restoration distortion and fuzzy details. At the same time, it also increases the amount of training required for generative confrontation network and increases the time required for training.

4.5. Development Trend of Face Completion

In view of the above shortcomings, scientists are starting to improve the generative adversarial network, and there are many development trends.

Update the algorithm and optimize the computation. By optimizing the algorithm and iterative function used, the computation required by the neural network is reduced, the system resources required by the computer to run the generative confrontation network are reduced, and the requirements for computer performance are reduced.

A new algorithm is used to reduce the number of training samples. The Adam gradient descent algorithm and the random gradient descent method are used to find the best number of iterations, so as to reduce the amount of training, optimize the training time and save the cost.

Add new network optimization to generate image details. Images repaired by generative adversarial networks, although roughly similar to the original image, but the details are still relatively rough. Therefore, scientists hope to enter the generative network by adding a new network such as the semantic perception network, so as to optimize the quality of repairing face images and increase the details of human face.

Add the network based on yolo series to preprocess the images. Before the occluded face images are input into the

generative adversarial network, the network of yolo series such as yolov4 is used to quickly locate the occlusion layer of the image, and highlight it. The generated network is assisted to accurately locate the occlusion layer, so as to improve the quality of the restored images, optimize the image details, and reduce the training time required for the generative adversarial network.

5. Conclusion

In this paper, the development history of face repair technology is reviewed, and the basic principle, shortcomings and development trend of face repair technology are summarized and prospected. It can be seen that the current face restoration technology can restore the face with high speed and accuracy. However, there are still some problems in face repair technology, such as large amount of computation, long training time and fuzzy details. Scientists have put forward some methods to solve these problems, such as optimizing the amount of computation by updating the algorithm, using new auxiliary algorithms to reduce the number of samples required, adding new networks to increase the details of face images, and increasing the image preprocessing stage. It is believed that future face repair technology will be widely popularized and can be effectively and conveniently applied to real life.

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