A Study Personal 2D Color Feature Image Interpolation

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Abstract

Surveillance Cameras such as CCTV easily found in places requiring security and the prevention of crimes such as public institutions, banks, etc. play an important role as they prevent all sorts of crimes, and provide a decisive clue for settling a criminal case. But, in case that a far-off person is photographed, an original image should be enlarged to identify the person. And as for the technique of enlarging an image, it is important to enlarge and restore it close to its original image rather than to merely magnify it. For the enlargement and restoration of an image, techniques called interpolation are used; as for interpolation methods known hitherto, however, .the higher the magnifying power is, the more deteriorated the quality of an image becomes to the extent that the image cannot be identified. Therefore, in this paper, we are going to propose a new technique whereby the face outline in an image is vectorized and restored by means of FDP (Facial Definition Parameter) standardized by the MPEG-4 SNHC FBA group, and an image is restored to have better quality than images restored with the existing interpolation.

1. Introduction

We can easily find a surveillance camera, such as CCTV, in places which require security and the prevention of crimes, such as public institutions, banks, etc. [1-2]. The use of CCTV is very wide such as security monitoring, industrial use, picture surveillance of vehicles, traffic control, and so on. Particularly, CCTV for security monitoring prevents all sorts of crimes, and provides a clue for settling a criminal case. The surveillance camera which plays such important roles also has a severe problem. Particularly in case that a far-off person is photographed, it is difficult to identify him/her exactly. Therefore, a photographed image should be enlarged to identify a person in the image; and a technique called 'interpolation' is generally used for such enlargement and restoration of an image[3-12].

As for the technique of enlarging an image, it is important to enlarge and restore it close to its original image rather than to merely magnify it. However, in the case of interpolation methods known hitherto, the higher their magnifying power is, the more the quality of an image drops to the extent that the image cannot be identified. The reason thereof is that their photographed images are of bitmap format. Considering the characteristics of bitmap-format images, the deterioration of the quality of an image after its enlargement is a natural result, To settle such problems inherent in bitmap images, we used in this paper the concept of vector image.

Particularly, images that this paper intends to restore are the images of human faces. If all faces to be restored are vectorized and then stored, images of excellent quality can be obtained; however, this is actually a very difficult method. Therefore, if only the overall features of a face which greatly affect human visual cognition are vectorized, images with better quality than those restored by means of simple interpolation methods alone.

2. Related Research

2.1 Facial Definition Parameter

The FBA (Face and Body Animation) group among many fields of MPG-4 SNHC (Synthetic Natural Hybrid Coding) standardized 3-dimensional avatas whereby human face and body are implemented in the virtual environment and animation is possible [13]. Particularly, FDP, parameters for facial definition, standardized by the FBA group defines important

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features with regard to the facial object, so that avatas may be represented in real time and that diverse motions may be represented. FDP represented 84 features of actual individual human faces. That is, if at least these 84 features are used, each individual's characteristic facial features can be represented [14].

Until now, the MPEG-4 SNHC FBA group has provided FDP on 6 models, that is, 3 models of Jim n, Claude n, and Chen n comprising 61 features excluding teeth, tongues, and so on, and 3 models of Charles, MIRAFace, and ISTmodel comprising all the features. FDP presented to MPEG-4 does not provide all information needed to generate a 3-dimensional facial object, such as the rear appearance of the head and the neck part. Figure 1 shows 61 features suggested in the standard plan, where teeth and tongues are not included [15-17].

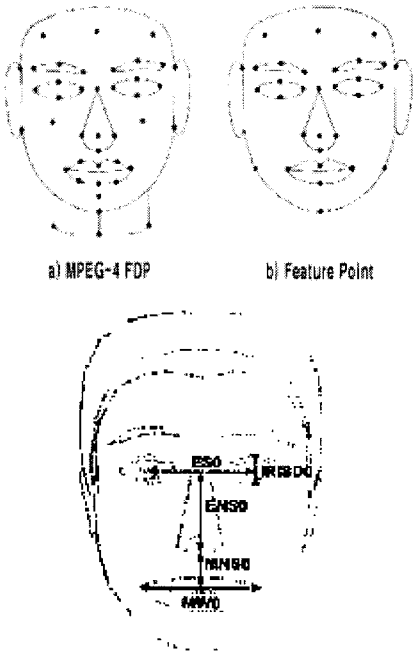


Figure 1. FDP Features

3. Technique of Restoration Using Face Outline Information

In the present text, we are going to restore an image by means of the bilinear interpolation among the several interpolation methods examined above, and of a method the present authors propose.

Figure 2 is one example of the bilinear interpolation. Here, the original image gives a far more vivid impression than the image after interpolation.

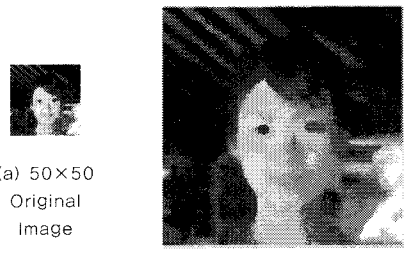
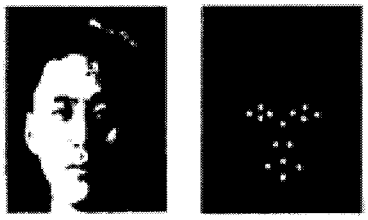


Figure 2. Original Image and Image after Bilinear Interpolation

This phenomenon is caused by blurring; and the interpolated image was much damaged while it was simply enlarged. To solve this problem, it would be desirable if there were the vector information of the original image. However, it cannot be secured in actuality; and so we are going to restore the image through vectorizing face elements which affect a lot the system of people's cognition.

3.1 Extraction of Facial Outline Information by Means of FDP Features & Image Restoration

In this paper, the facial outline is separately vectorized and restored; and for the others except the facial outline, the bilinear interpolation, the basic interpolation, is used. First, enlarge the original image, for it is small, and so it is difficult to extract FDP features. And, as shown in Figure 3, conduct operations to match with the original image the coordinates of 51 features among 84 features provided by FDP, except information on ears (10.1~10.6), eyelids (3.9, 3.10, 3.13, 3.14), and teeth. Determine the location of features so that the location of coordinates may be in agreement with the proportion of the face in the original image according to the definition of FDP provided by MPEG-4. It is difficult to determine exact location, because the image to be restored is a very small one. Therefore, in consideration of location provided by FDP, enlarge the original image, and match it to the pointers of parts necessary for restoration.



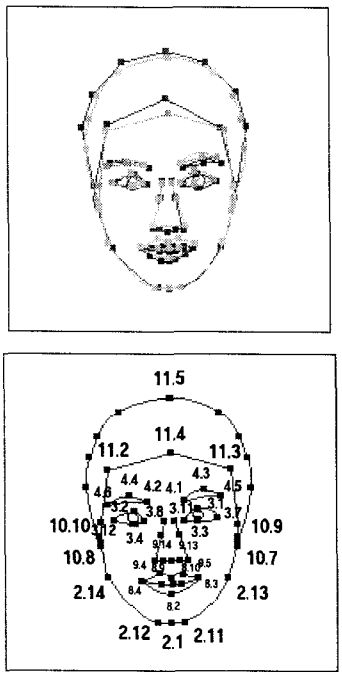
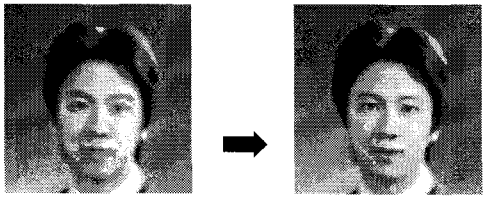


Figure 3. Matching FDP Features to Enlarged Image

To describe more in detail the algorithm of extracting the face outline information explained in 3.1, enlarge the original image; determine FDP features; and then vectorize and extract the face outline. Reduce this outline on the scale of the original image; and match it. If the pixel values of the face outline in the original image are obtained from the matched image, perfect vector information is obtained. Then, in the final stage of the image restoration, if this vector data is applied to an enlarged image, a restored image of better quality is obtained. That is, match it to the enlarged image, as in Figure 4.



(a) Enlarging Vector Image (b) Matching to Enlarged Image

Figure 4. Process of Face Restoration

4. Results of Experiment, and Plan for Improvement

As explained in the above process, the final image as in Figure 5 was obtained by means of the bilinear interpolation and a method proposed by the present writer. To review the final image, it can be seen that restoration was made into one of far more excellent quality(though this may be subjective judgment).

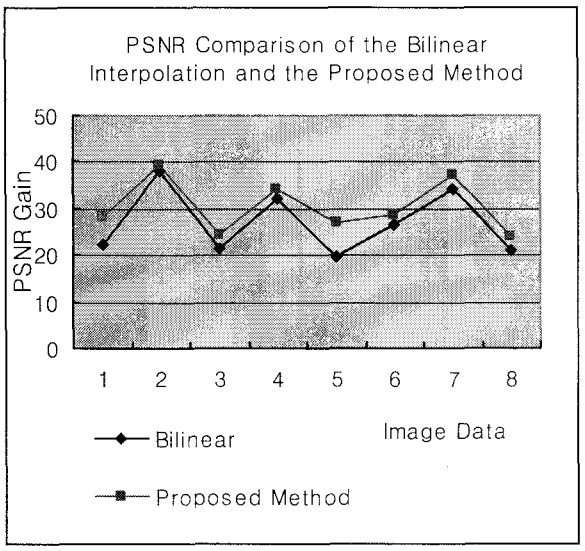
(a) Bilinear Interpolation (b) Proposed Method

Figure 5. Resultant Images of the Existing Method and of a Proposed Method

For the objective judgment of the algorithm proposed, we compared, by means of PSNR values, the images restored by the bilinear interpolation and the images restored by the proposed method..

Table 1. PSNR Comparison of the Bilinear Interpolation and the Proposed Method

	Bilinear Interpolation	Proposed Method	PSNR Gain
Image 1	22.21	28.32	6.11
Image 2	38	39.14	1.14
Image 3	21.58	24.16	2.58
Image 4	32	34.22	2.22
Image 5	19.54	26.74	7.2
Image 6	26.31	28.55	2.24
Image 7	34.12	37	2.88
Image 8	21.14	23.8	2.66
Average	26.86	30.24	3.38



In the PSNR comparison of enlarged images, the interpolation algorithm proposed in this paper showed the improvement of about average 0.8 db as to several images, as in Table 1. Therefore, it can be seen that the proposed method is considerably effective irrespective of gender and facial expression.

5. Conclusion

In case of enlarging an image, the technique of interpolation is employed. The interpolation refers to generating newly a suitable pixel value into an empty cell resulted from the image enlargement. Therefore, the more the number of cells whose pixel value should be generated is, the more deteriorated the image quality is. In this paper, we proposed a new method to improve such problem of the existing interpolation.

As for future research subjects, how will an image which was not photographed from the front, that is, an inclined image, be processed? And if a program which can find out FDA information automatically for the convenience of operation, the results of this study can be used far more easily.

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