Results Section

Paper: Facial Expression Preserving Privacy Protection Using Image Melding

Group 7, Chen Genwen

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Part 1

Elements of the Results section

- Elements
- Skills

3. EXPERIMENTAL RESULTS

We objectively and subjectively verified the proposed method's capability for privacy protection using a face recognition technique and questionnaire. Our subjective survey also show whether it retains facial expression. We also subjectively surveyed if protected images are visually intrusive. Our dataset contains 8 subjects' frontal faces in happiness, disgust, and neutral expressions as well as other 8 subjects' profile face in the same facial expressions.

For comparison, we employed blurring and morphing. The Gaussian kernel with size κ was used for blurring. For morphing, since the work [11] did not detail the positions of 21 corresponding points, we alternatively used 27 corresponding points in [16] for frontal faces. Since no literature has reported corresponding points for profile face, we used 21 points on the contour of a face and around facial features. After Delauney triangulation, our implementation of morphing locally transformed the source image so that the points on it coincided their corresponding points on the target image. The transformed image was mixed with the target image with a constant weight α. Compared with [11], which transforms both source and target images to match the corresponding points, this implementation is expected to preserve facial expression. The parameter value θ to determine the weight for pixel replacement in Section 2.1 is set to 5% of the width of source images (face regions). We used three parameter values for each method, which are summarized in Table 1. For all these parameters, a larger value changes target images more, which can provide stronger privacy protection.

3. Experimental Results

3.1 Capability for privacy protection

3.2 Capability for preserving facial expression

3.3 Subjective evaluation of visual intrusiveness

Elements of the Results section		Occurrence
Methods/approaches		Optional
The location of the results		Required
Presentation of major results		Required
Provision of specific data		Required
Comments	Evaluation	Required
	Comparison	Optional
	Explanation	Optional

Five writing skills used in the Results section

- Locate the tables and figures where the results can be found
- Highlight major results or findings
- Provide specific data to support the results or findings
- Provide comments(evaluation, comparison and/or explanation) on some of the results
- Avoid presenting all the data in the tables or figures and avoid duplicating in the text what as been presented in a table or figure

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disclosed) to 5 (completely protected). Some example face images used in the evaluation are shown in Fig. 3.

Figures 4(left) and (right) are the results for Scenarios (A) and (B), respectively. The results demonstrate that the capability of the proposed method with parameter (iii) is slightly worse than that for blurring with (ii) and is almost the same as morphing with (iii). Meanwhile, our subjects mostly felt

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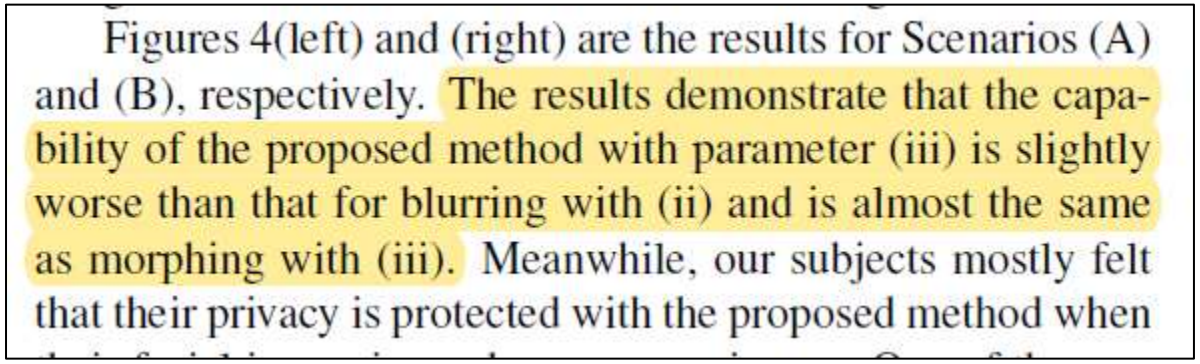

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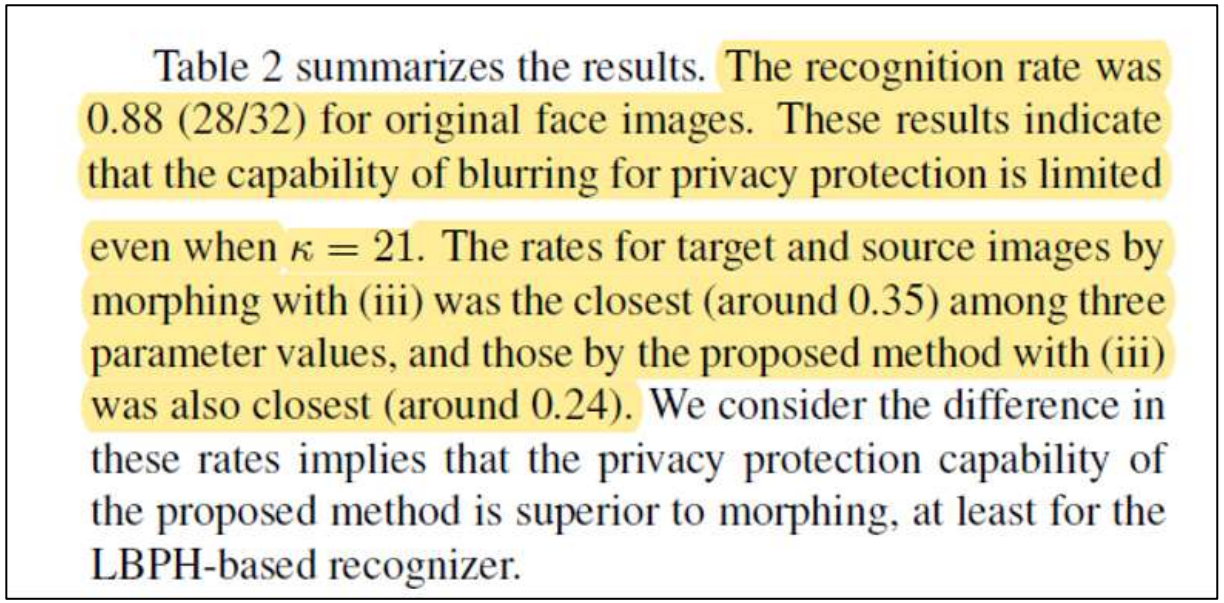

Table 2 summarizes the results. The recognition rate was 0.88 (28/32) for original face images. These results indicate that the capability of blurring for privacy protection is limited even when $\kappa = 21$. The rates for target and source images by morphing with (iii) was the closest (around 0.35) among three parameter values, and those by the proposed method with (iii) was also closest (around 0.24). We consider the difference in these rates implies that the privacy protection capability of the proposed method is superior to morphing, at least for the LBPH-based recognizer.

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Table 2. Recognition rates. The numbers in parentheses are correct recognitions among 32 trials.

Parameter	(i)	(ii)	(iii)
Blurring	0.53 (17)	0.56 (18)	0.38 (12)
Morphing (Target)	0.53 (17)	0.41 (13)	0.38 (12)
Morphing (Source)	0.09 (3)	0.19 (6)	0.31 (10)
Proposed (Target)	0.44 (14)	0.31 (10)	0.22 (7)
Proposed (Source)	0.16 (5)	0.19 (6)	0.25 (8)

Figures 4(left) and (right) are the results for Scenarios (A) and (B), respectively. The results demonstrate that the capability of the proposed method with parameter (iii) is slightly worse than that for blurring with (ii) and is almost the same as morphing with (iii). Meanwhile, our subjects mostly felt

Part 2

Data presentation

Three suggestions followed in the Results section

- Design and choose the appropriate tables and figures so that the comprehension will be more rapid and the message clearer.
- Make figures and tables stand alone. That is, readers could understand the results presented in figures/tables without consulting the written text.
- Number and present figures and tables in the order in which they are referred to in the text (figures and tables are number separately). Be sure that each table and figure is cited in the text.

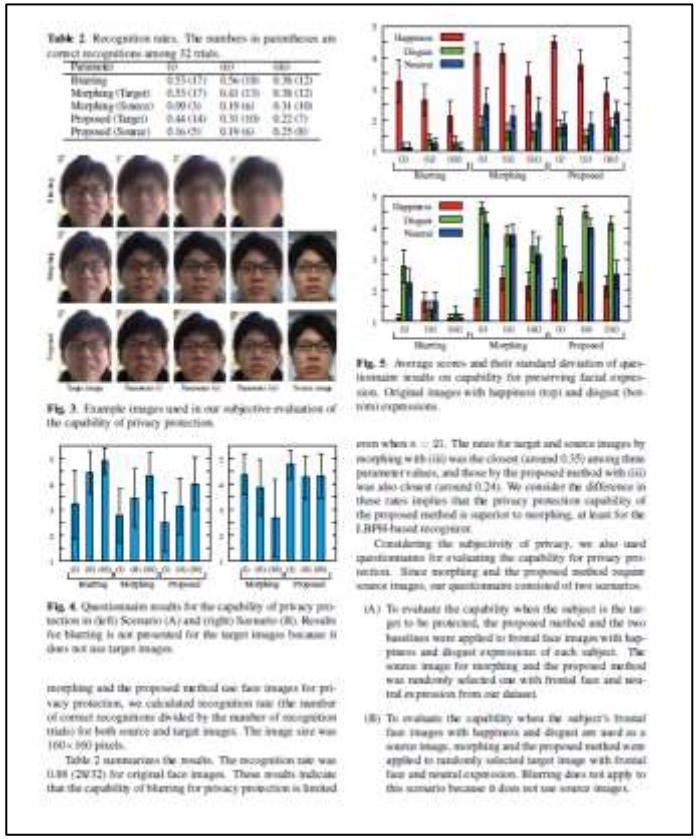

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Fig. 3. Example images used in our subjective evaluation of the capability of privacy protection.

Fig. 4. Questionnaire results for the capability of privacy protection in (left) Scenario (A) and (right) Scenario (B). Results for blurring is not presented for the target images because it does not use target images.

Fig. 5. Average scores and their standard deviation of questionnaire results on capability for preserving facial expression. Original images with happiness (top) and disgust (bottom) expressions.

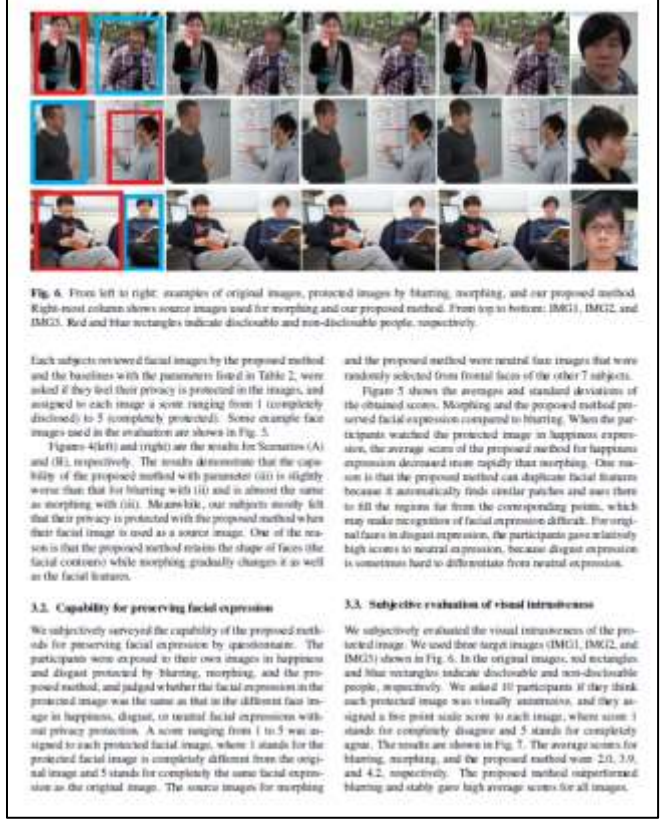

Fig. 6. From left to right: examples of original images, protected images by blurring, morphing, and our proposed method. Right-most column shows source images used for morphing and our proposed method. From top to bottom: IMG1, IMG2, and IMG3. Red and blue rectangles indicate disclosable and non-disclosable people, respectively.

The principle followed in the Results section

Writers should make ensure that the readers and reviewers be able to identify which specific hypotheses were supported, which had only partial support, and which were not supported.

signed a five point scale score to each image, where score 1 stands for completely disagree and 5 stands for completely agree. The results are shown in Fig. 7. The average scores for blurring, morphing, and the proposed method were 2.0, 3.9, and 4.2, respectively. The proposed method outperformed blurring and stably gave high average scores for all images.

Part 3

Data commentary

There elements of the structure of data commentary

- **Element 1:** A statement that locates the figure(s) where the results can be found (Location elements);
- **Element 2**: Statements that present the most important findings (Highlighting elements);
- **Element 3**: Statements that comment on the results (Commenting elements / interpretations / implications).

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The patterns of organizing commentary

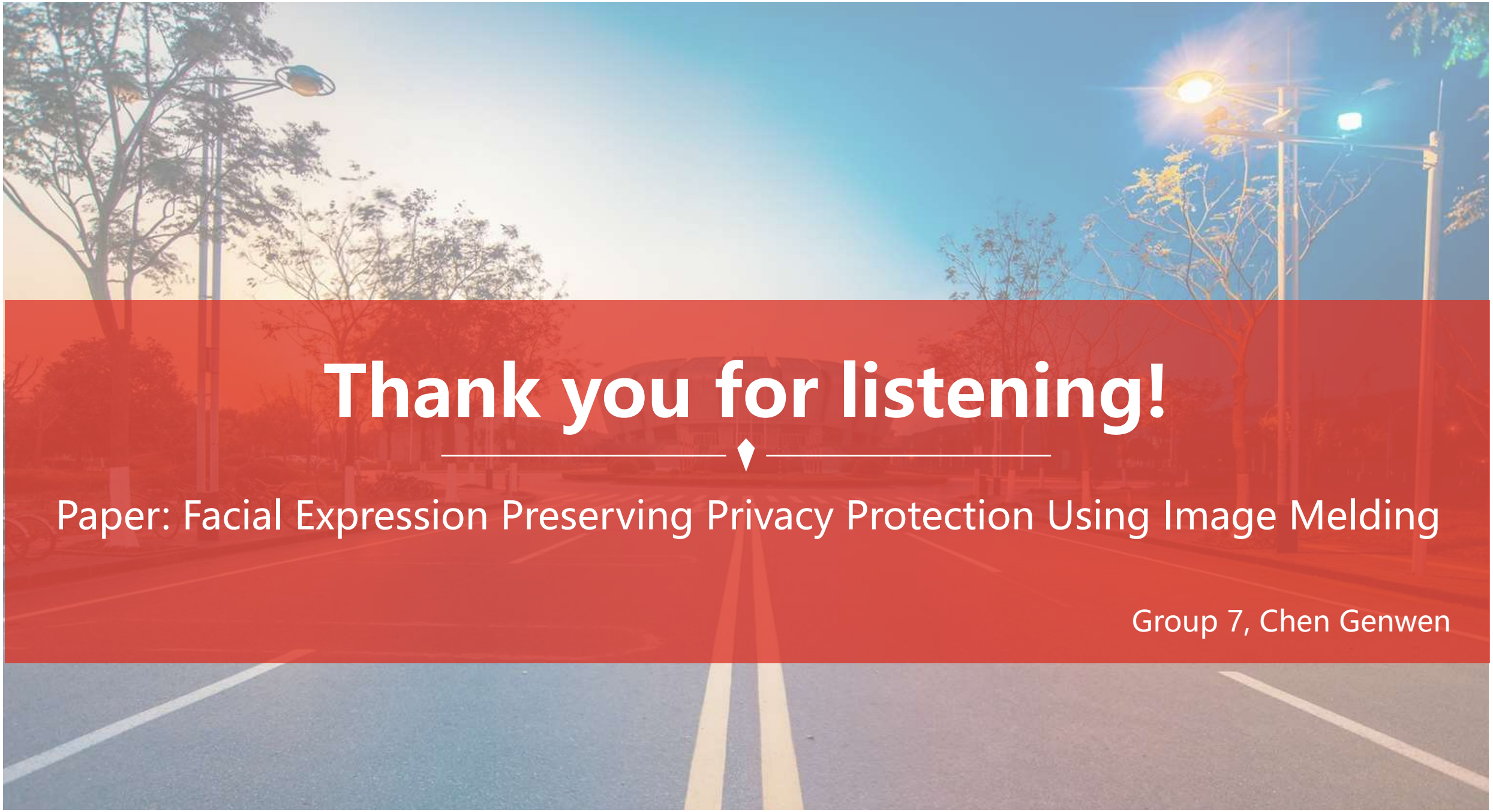
Alternating pattern

Each subjects reviewed facial images by the proposed method and the baselines with the parameters listed in Table 2, were asked if they feel their privacy is protected in the images, and assigned to each image a score ranging from 1 (completely disclosed) to 5 (completely protected). Some example face images used in the evaluation are shown in Fig. 3.

Figures 4(left) and (right) are the results for Scenarios (A) and (B), respectively. The results demonstrate that the capability of the proposed method with parameter (iii) is slightly worse than that for blurring with (ii) and is almost the same as morphing with (iii). Meanwhile, our subjects mostly felt that their privacy is protected with the proposed method when their facial image is used as a source image. One of the reason is that the proposed method retains the shape of faces (the facial contours) while morphing gradually changes it as well as the facial features.

and the proposed method were neutral face images that were randomly selected from frontal faces of the other 7 subjects.

Figure 5 shows the averages and standard deviations of the obtained scores. Morphing and the proposed method preserved facial expression compared to blurring. When the participants watched the protected image in happiness expression, the average score of the proposed method for happiness expression decreased more rapidly than morphing. One reason is that the proposed method can duplicate facial features because it automatically finds similar patches and uses them to fill the regions far from the corresponding points, which may make recognition of facial expression difficult. For original faces in disgust expression, the participants gave relatively high scores to neutral expression, because disgust expression is sometimes hard to differentiate from neutral expression.



Thank you for listening!

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