Style transfer effectiveness for forensic sketch and photo matching

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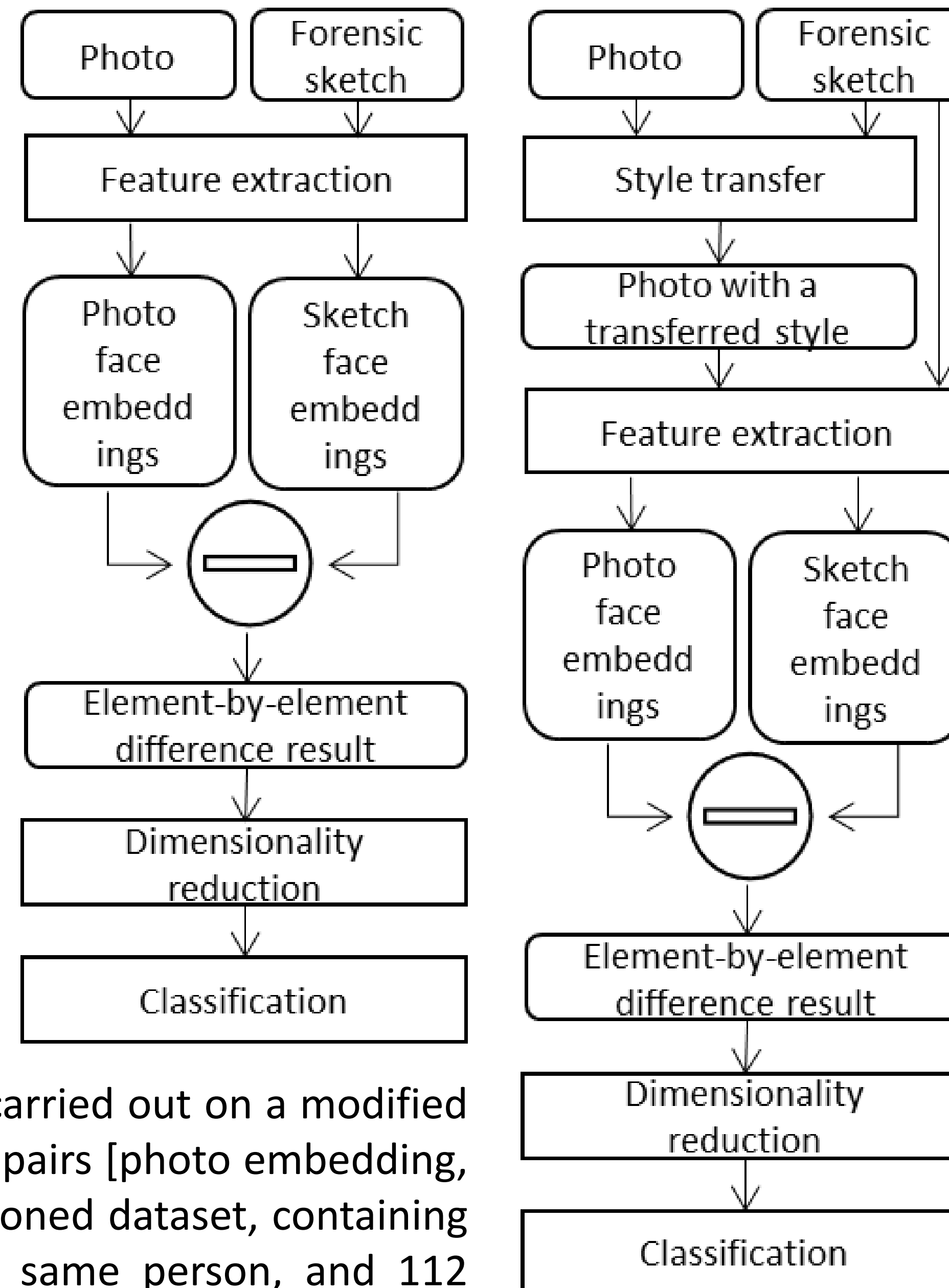
General information

In this paper, the problem of comparing portrait photographic images and forensic sketches is considered. The paper analyzes the feasibility and potential advantage of applying style transfer methods to solve this problem. A method for comparing photographic and synthetic images is proposed. It consists of the feature extraction from a pair of images, the subsequent element-by-element difference between feature vectors, and further classification. We also consider a modification of the proposed method, which uses the style transfer from a sketch to a photographic image.

The extraction of features (face embeddings) is based on the ResNet50 model with the usage of the ArcFace loss function. In our work, the best classification metrics were obtained while maintaining the 16 most significant components of the original feature vectors, so we suggest using that number for the current experimental setup. We have used a pre-trained model based on VGG architecture for style transfer. For classification in this research, quadratic discriminant analysis was used.

Experimental research of the two mentioned methods is carried out on a modified Tufts Face Database images. For this work, a balanced set of pairs [photo embedding, composite portrait embedding] is assembled from the mentioned dataset, containing 112 correct pairs, where both embeddings belong to the same person, and 112 incorrect ones, where embeddings belong to different people.

Within the framework of the proposed method, the improvement in classification metrics was about **10-12%**
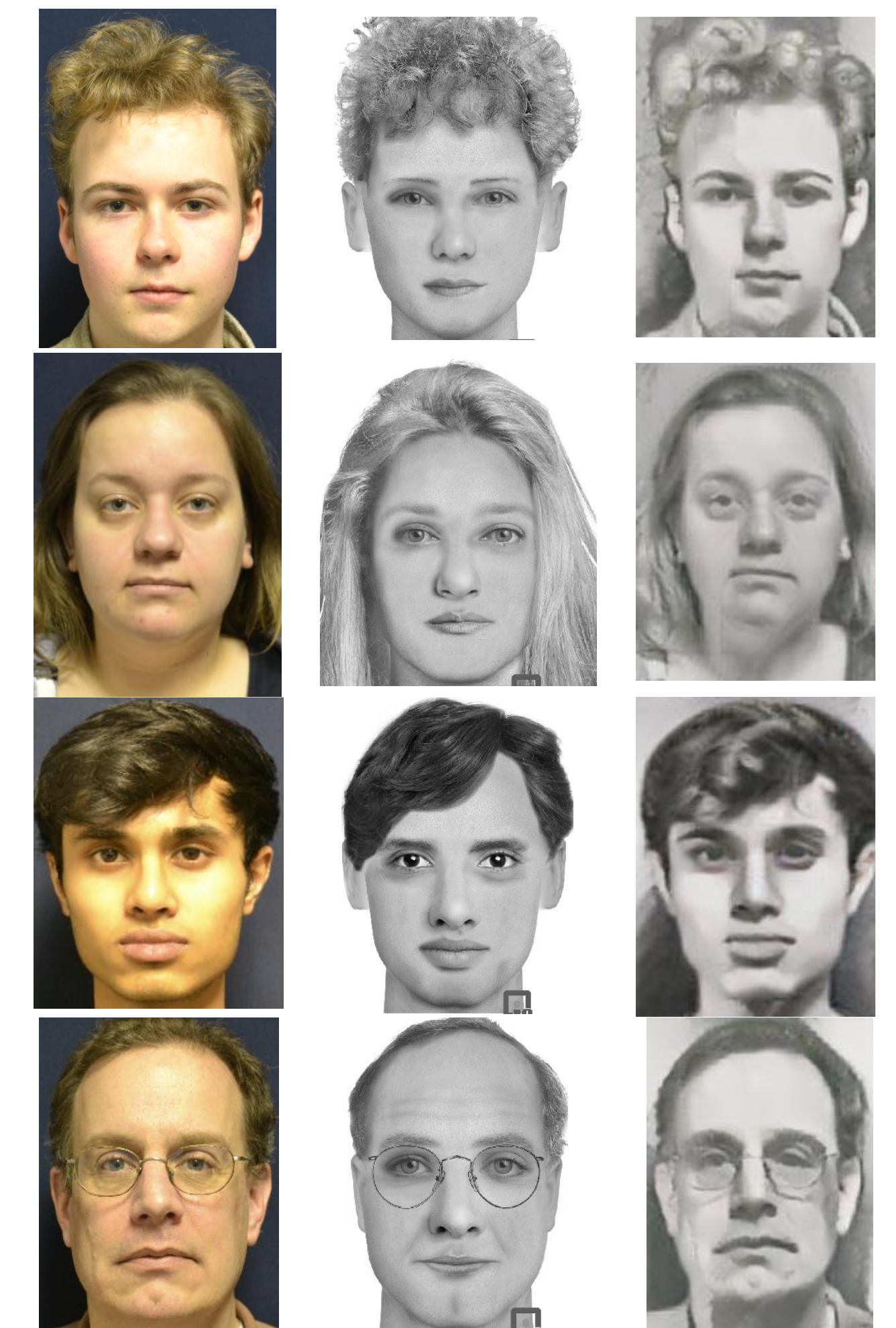
The examined sketch-photo matching methods - the original (left) and the modified one (right)

Examples of images used in research: photographic portraits (left), synthetic forensic sketches (middle), style transfer results (right).

Confusion matrices for the method without style transfer (left) and for the method with style transfer (right)

Classification metrics results

Considered method	Precision	Recall	Accuracy	F-score
Without style transfer	0.72	0.67	0.71	0.69
With style transfer	0.82	0.79	0.81	0.80