Claims

1. A method for training generative models, the method comprising:

receiving, by a processing device, a training facial image in a first complexion;

generating, using the processing device, a synthetic facial image in a second complexion using a first generative model, based on the training facial image in the first complexion;

generating, using the processing device, a synthetic facial image in the first complexion using a second generative model, based on the synthetic facial image in the second complexion~~ by converting the second complexion of the synthetic facial image to the first complexion of the training facial image~~;

calculating, using the processing device, an identity classification loss value using an identity loss minimisation model, based on differences in facial features of the training facial image and the synthetic facial image in the first complexion, wherein the facial features are used in a face recognition model to establish an identity of a subject; ~~and~~

updating, using the processing device, the first generative model and the second generative model based on the identity classification loss value;

generating, using a first conditional model, a probability score indicating whether a facial image in the first complexion is synthetic; and

determining, based on the probability score, that the facial image in the first complexion is synthetic.

2. The method as claimed in claim 1, ~~further comprising:~~

~~determining, using the processing device, if a facial image in the first complexion is a synthetic facial image using a first conditional model,~~wherein the first conditional model is configured to minimise an error rate associated with misclassification of the facial image in the first complexion,~~;~~ and wherein the method further comprises:

updating, using the processing device, the first and the second generative models based on the determination, to maximise the error rate associated with misclassification of the facial image in the first complexion.

3. The method as claimed in claim 1 or 2, further comprising:

determining, using the processing device, a first cycle consistency loss value based on differences in pixel values of the training facial image and the synthetic facial image in the first complexion; and

updating, using the processing device, the first and the second generative models based on the first cycle consistency loss value, to minimise the first cycle consistency loss value.

4. The method as claimed in claim 1, further comprising:

receiving, by the processing device, a training facial image in the second complexion;

generating, using the processing device, a synthetic facial image in the first complexion using the second generative model, based on the training facial image in the second complexion;

generating, using the processing device, a synthetic facial image in the second complexion using the first generative model, based on the synthetic facial image in the first complexion;

determining, using the processing device, if a facial image in the second complexion is a synthetic facial image using a second conditional model, the second conditional model configured to minimise an error rate associated with misclassification of the facial image in the second complexion; and

updating, using the processing device, the first and the second generative models based on the determination, to maximise the error rate associated with misclassification of the facial image in the second complexion.

5. The method as claimed in claim 4, further comprising:

determining, using the processing device, a second cycle consistency loss value based on differences in pixel values of the training facial image and the synthetic facial image in the second complexion; and

updating, using the processing device, the first and the second generative models based on the second cycle consistency loss value, to minimise the second cycle consistency loss value.

6. A system for training generative models, the system comprising:

a processing device configured to:

receive a training facial image in a first complexion;

generate a synthetic facial image in a second complexion using a first generative model, based on the training facial image in the first complexion;

generate a synthetic facial image in the first complexion using a second generative model, based on the synthetic facial image in the second complexion

~~by converting the second complexion of the synthetic facial image to the first complexion of the training facial image~~;

calculate an identity classification loss value using an identity loss minimisation model, based on differences in facial features of the training facial image and the synthetic facial image in the first complexion, wherein the facial features are used in a face recognition model to establish an identity of a subject; ~~and~~

update the first generative model and the second generative model based on the identity classification loss value;

generate, using a first conditional model, a probability score indicating whether a facial image in the first complexion is synthetic; and

determine, based on the probability score, that the facial image in the first complexion is synthetic.

7. The system as claimed in claim 6, ~~the processing device further configured to:~~

~~determine if a facial image in the first complexion is a synthetic facial image using a first conditional model,~~wherein the first conditional model is configured to minimise an error rate associated with misclassification of the facial image in the first complexion,~~;~~ and wherein the processing device is further configured to:

update the first and the second generative models based on the determination, to maximise the error rate associated with misclassification of the facial image in the first complexion.

8. The system as claimed in claim 6 or 7, the processing device further configured to:

determine a first cycle consistency loss value based on differences in pixel values of the training facial image and the synthetic facial image in the first complexion; and

update the first and the second generative models based on the first cycle consistency loss value, to minimise the first cycle consistency loss value.

9. The system as claimed in claim 6, the processing device further configured to:

receive a training facial image in the second complexion;

generate a synthetic facial image in the first complexion, using the second generative model, based on the training facial image in the second complexion;

generate a synthetic facial image in the second complexion, using the first generative model, based on the synthetic facial image in the first complexion;

determine if a facial image in the second complexion is a synthetic facial image using a second conditional model, the second conditional model configured to minimise an error rate associated with misclassification of the facial image in the second complexion; and

update first and the second generative models based on the determination, to maximise the error rate associated with misclassification of the facial image in the second complexion.

10. The system as claimed in claim 9, wherein the processing device is further configured to:

determine a second cycle consistency loss value based on differences in pixel values of the training facial image and the synthetic facial image in the second complexion; and

update the first and the second generative models based on the second cycle consistency loss value, to minimise the second cycle consistency loss value.

11. A method for training a face recognition model, the method comprising:

receiving, by a processing device, an identified facial image in a source complexion;

generating, using the processing device, an identified facial image in a target complexion based on the received facial image using a generative model, the generative model trained using a cycle generative adversarial network; and

training, using the processing device, the face recognition model with the identified facial images in the source and the target complexions;

wherein the cycle generative adversarial network comprises:

a first generative model configured to generate, based on a training facial image in a first complexion, a synthetic facial image in a second complexion;

a second generative model configured to generate, based on the synthetic facial image in the second complexion, a synthetic facial image in the first complexion by converting the second complexion of the synthetic facial image to the first complexion of the training facial image; ~~and~~

an identity loss minimisation model configured to calculate an identity classification loss value based on differences in facial features of the training facial image and the synthetic facial image in the first complexion, wherein the facial features are used in the face recognition model to establish an identity of a subject; and

a first conditional model configured to:

generate a probability score indicating whether a facial image in the first complexion is synthetic; and

determine, based on the probability score, that the facial image in the first complexion is synthetic;

wherein the first and second generative models are trained using the cycle generative adversarial network to minimise the identity classification loss; and

wherein the generative model is the first generative model.

12. The method as claimed in claim 11, wherein ~~the cycle generative adversarial network further comprises:~~

~~a first conditional model configured to classify if a facial image in the first complexion is a synthetic facial image,~~ the first conditional model is trained to minimise an error rate associated with misclassification of the facial image in the first complexion; and

wherein the first and the second generative models are trained using the cycle generative adversarial network to maximise the error rate associated with misclassification of the facial image in the first complexion.

13. The method as claimed in claim 11 or 12, wherein the cycle generative adversarial network further comprises:

a first cycle consistency loss minimisation model configured to determine a first cycle consistency loss value based on differences in pixel values of the training facial image and the synthetic facial image in the first complexion;

wherein the first and second generative models are trained using the cycle generative adversarial network to minimise the first cycle consistency loss value determined by the first cycle consistency loss minimisation model.

14. The method as claimed in claim 11, wherein the second generative model is configured to generate a synthetic facial image in the first complexion, based on a training facial image in the second complexion;

wherein the first generative model configured to generate a synthetic facial image in the second complexion, based on the synthetic facial image in the first complexion; and

wherein the cycle generative adversarial network further comprises:

a second conditional model configured to classify if a facial image in the second complexion is a synthetic facial image, the second conditional model trained to

minimise an error rate associated with misclassification of the facial image in the second complexion;

wherein the first and the second generative models are trained using the cycle generative adversarial network to maximise the error rate associated with misclassification of the facial image in the second complexion.

15. The method as claimed in claim 14, wherein the cycle generative adversarial network further comprises:

a second cycle consistency loss minimisation model configured to determine a second cycle consistency loss value based on differences in pixel values of the training facial image and the synthetic image of the subject in the second complexion; and

wherein the first and second generative models are trained using the cycle generative adversarial network to minimise the second cycle consistency loss value determined by the second cycle consistency loss minimisation model.

16. A system, comprising:

a processing device configured to:

receive an identified facial image in a source complexion;

generate an identified facial image in a target complexion based on the received facial image using a generative model, the generative model trained using a cycle generative adversarial network; and

train a face recognition model with the identified facial images in the source and the target complexions;

wherein the cycle generative adversarial network comprises:

a first generative model configured to generate, based on a training facial image in a first complexion, a synthetic facial image in a second complexion;

a second generative model configured to generate, based on the synthetic facial image in the second complexion, a synthetic facial image in the first complexion by converting the second complexion of the synthetic facial image to the first complexion of the training facial image; ~~and~~

an identity loss minimisation model configured to calculate an identity classification loss value based on differences in facial features of the training facial image and the synthetic facial image in the first complexion, wherein the facial features are used in the face recognition model to establish an identity of a subject; and

a first conditional model configured to:

generate a probability score indicating whether a facial image in the first complexion is synthetic; and

determine, based on the probability score, that the facial image in the first complexion is synthetic;

wherein the first and second generative models are trained using the cycle generative adversarial network to minimise the identity classification loss; and

wherein the generative model is the first generative model.

17. The system as claimed in claim 16, wherein ~~the cycle generative adversarial network further comprises:~~

~~a first conditional model configured to classify if a facial image in the first complexion is a synthetic facial image,~~ the first conditional model is trained to minimise an error rate associated with misclassification of the facial image in the first complexion~~;~~, and

wherein the first and the second generative models are trained using the cycle generative adversarial network to maximise the error rate associated with misclassification of the facial image in the first complexion.

18. The system as claimed in claim 16 or 17, wherein the cycle generative adversarial network further comprises:

a first cycle consistency loss minimisation model configured to determine a first cycle consistency loss value based on differences in pixel values of the training facial image and the synthetic facial image in the first complexion;

wherein the first and second generative models are trained using the cycle generative adversarial network to minimise the first cycle consistency loss value determined by the first cycle consistency loss minimisation model.

19. The system as claimed in claim 18, wherein the second generative model is configured to generate a synthetic facial image in the first complexion, based on a training facial image in the second complexion;

wherein the first generative model configured to generate a synthetic facial image in the second complexion, based on the synthetic facial image in the first complexion; and

wherein the cycle generative adversarial network further comprises:

a second conditional model configured to classify if a facial image in the second complexion is a synthetic facial image, the second conditional model trained to

minimise an error rate associated with misclassification of the facial image in the second complexion;

wherein the first and the second generative models are trained using the cycle generative adversarial network to maximise the error rate associated with misclassification of the facial image in the second complexion.

20. The system as claimed in claim 19, wherein the cycle generative adversarial network further comprises:

a second cycle consistency loss minimisation model configured to determine a second cycle consistency loss value based on differences in pixel values of the training facial image and the synthetic image of the subject in the second complexion; and

wherein the first and second generative models are trained using the cycle generative adversarial network to minimise the second cycle consistency loss value determined by the second cycle consistency loss minimisation model.

21. The method as claimed in claim 1, wherein the first conditional model is trained using a plurality of training facial images in the first complexion having a first label and a plurality of synthetic facial images in the first complexion having a second label, and wherein the first label and the second label are different.