# StyleDemorpher: High-Quality Face Demorphing via StyleGAN2's Latent Space
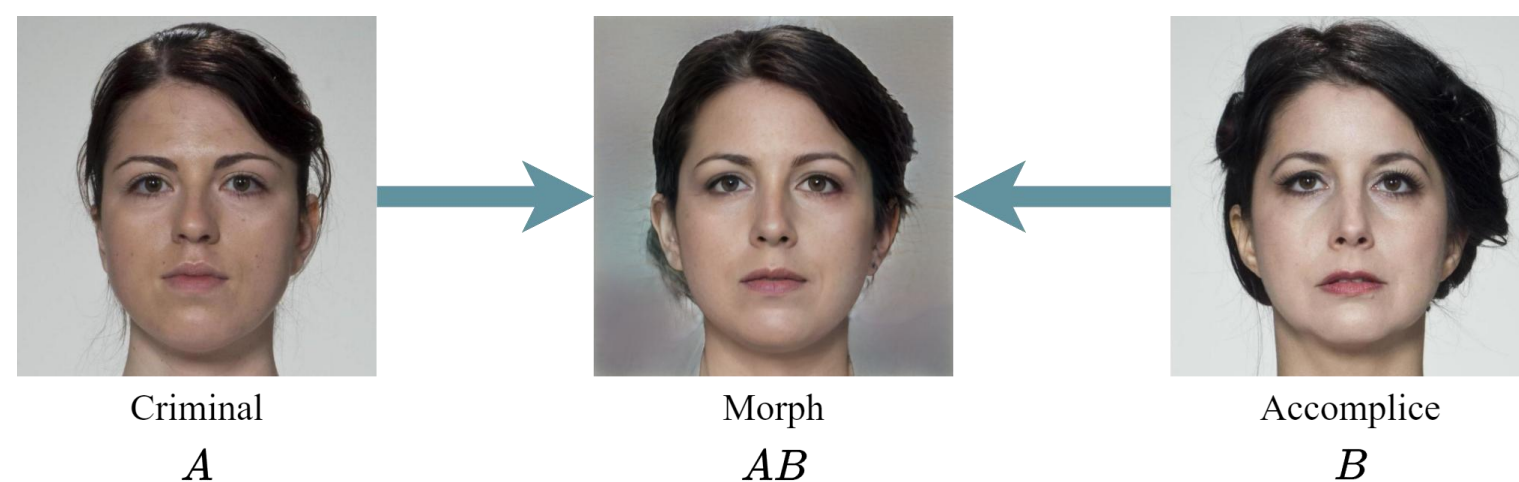
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## Introduction

Face morphing combines facial features of two individuals:



Criminal $A$ — Morph $AB$ — Accomplice $B$

Criminals can exploit travel documents with morphed images to illegally assume an accomplice's identity, posing a significant threat to automated border control systems. By blending features from two individuals, morphing enables multiple people to use the same document, undermining border security.

Face demorphing aims to counteract this by reconstructing the accomplice's identity using the document image and a trusted live capture of the criminal [1].



Morph $AB$ + Trusted Live Capture of the Criminal $A'$ → Face Demorphing → Reconstruction of the Accomplice $\hat{B}$
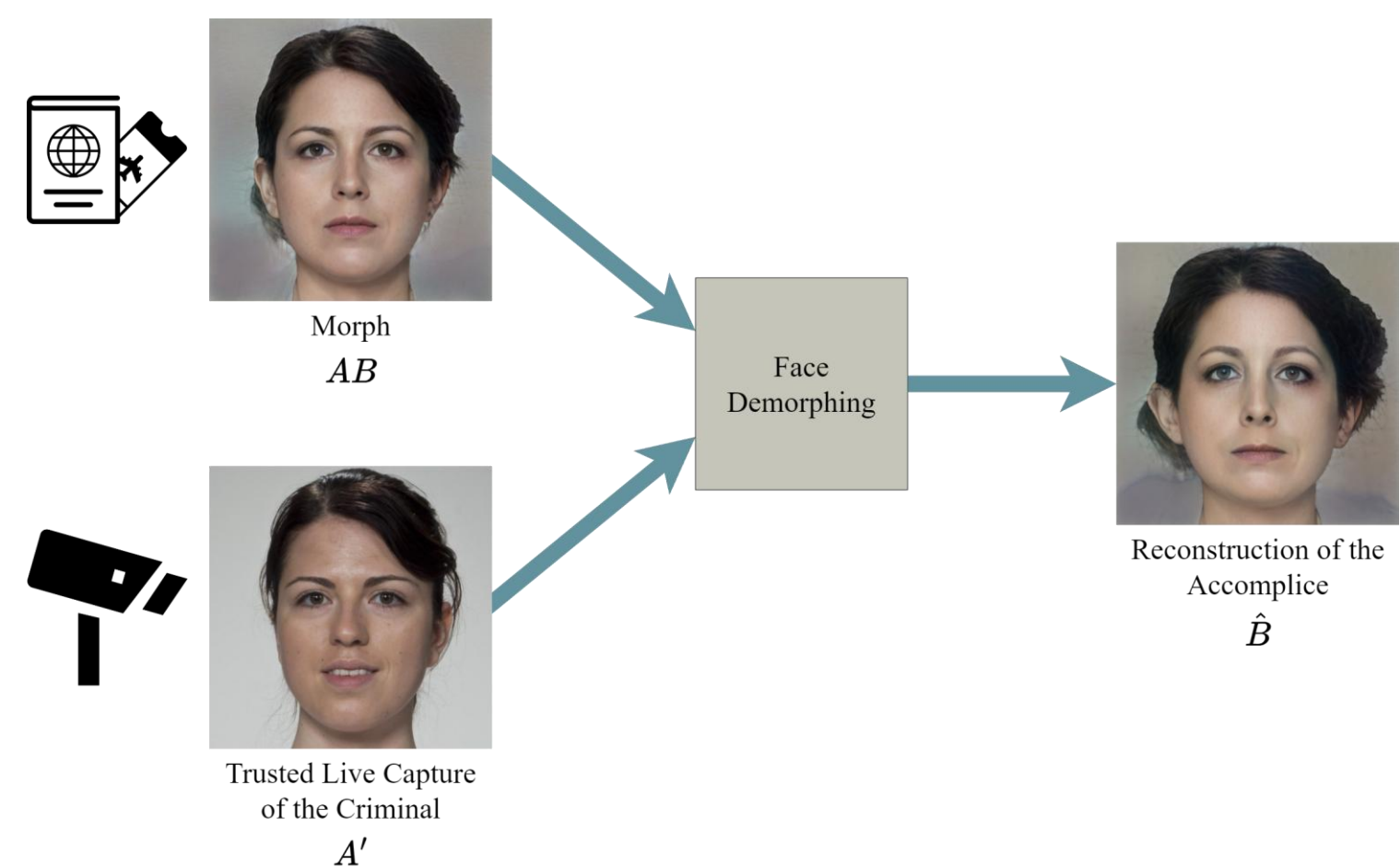
## Challenges

- Low-resolution reconstructions.
- Limited training datasets.
- Morphed images contain only partial traces of the accomplice's identity.
- Morphed images are generated using unknown morphing methods.
- Trusted live capture conditions (illumination, pose, expression) differ from those used to create the morphed document image ($A \neq A'$).

## Methodology

Pre-trained StyleGAN2 [2] is used to generate high-resolution, demorphed faces by performing latent space manipulation using proposed ReStyle-ID and StyleDemorpher frameworks.
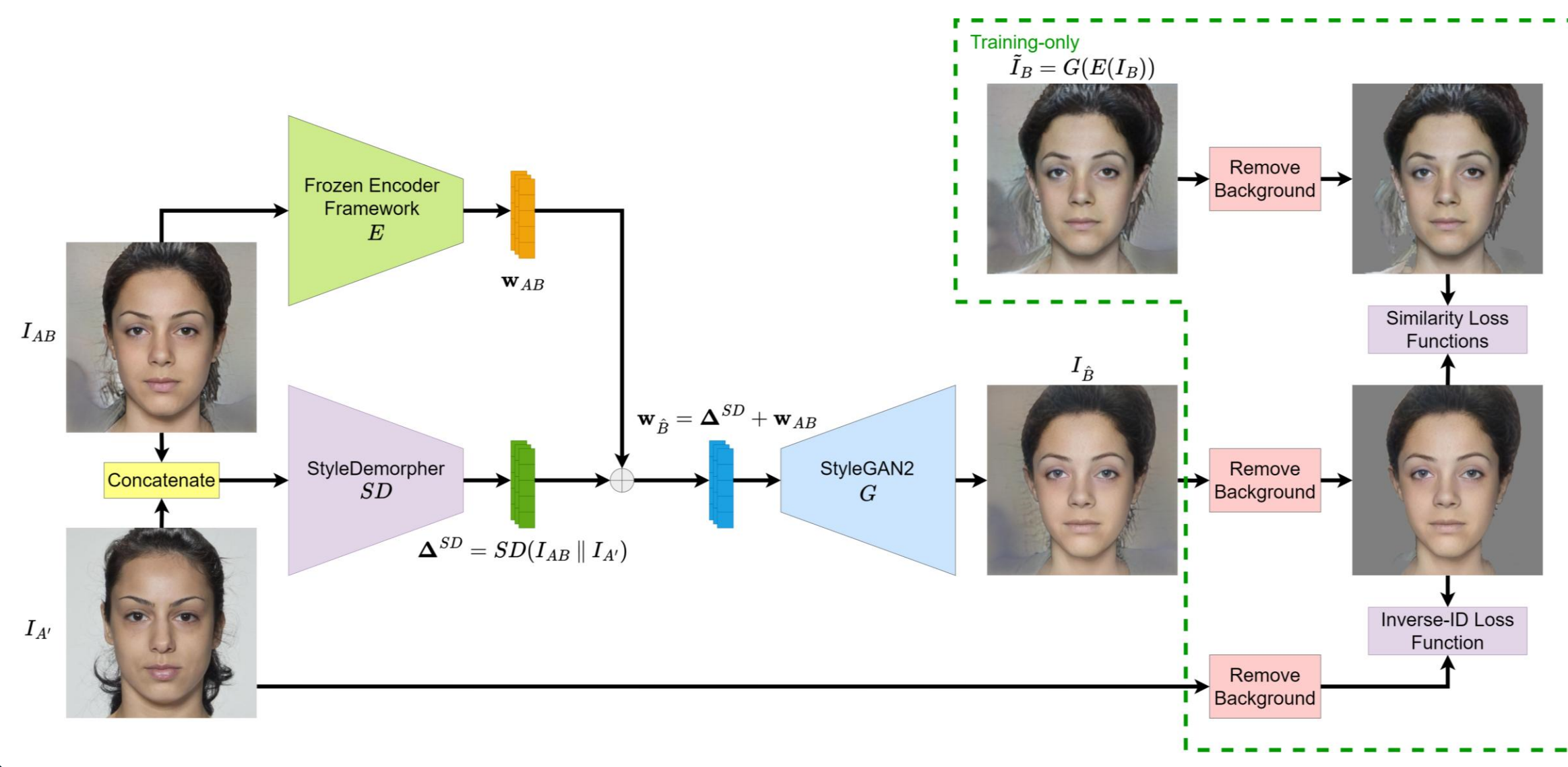
### ReStyle-ID Framework

- Iterative encoder network mapping real identities into StyleGAN2's latent space.
- Maximizes identity preservation via an improved identity loss function.
- Ignores background during training for focused identity reconstruction.
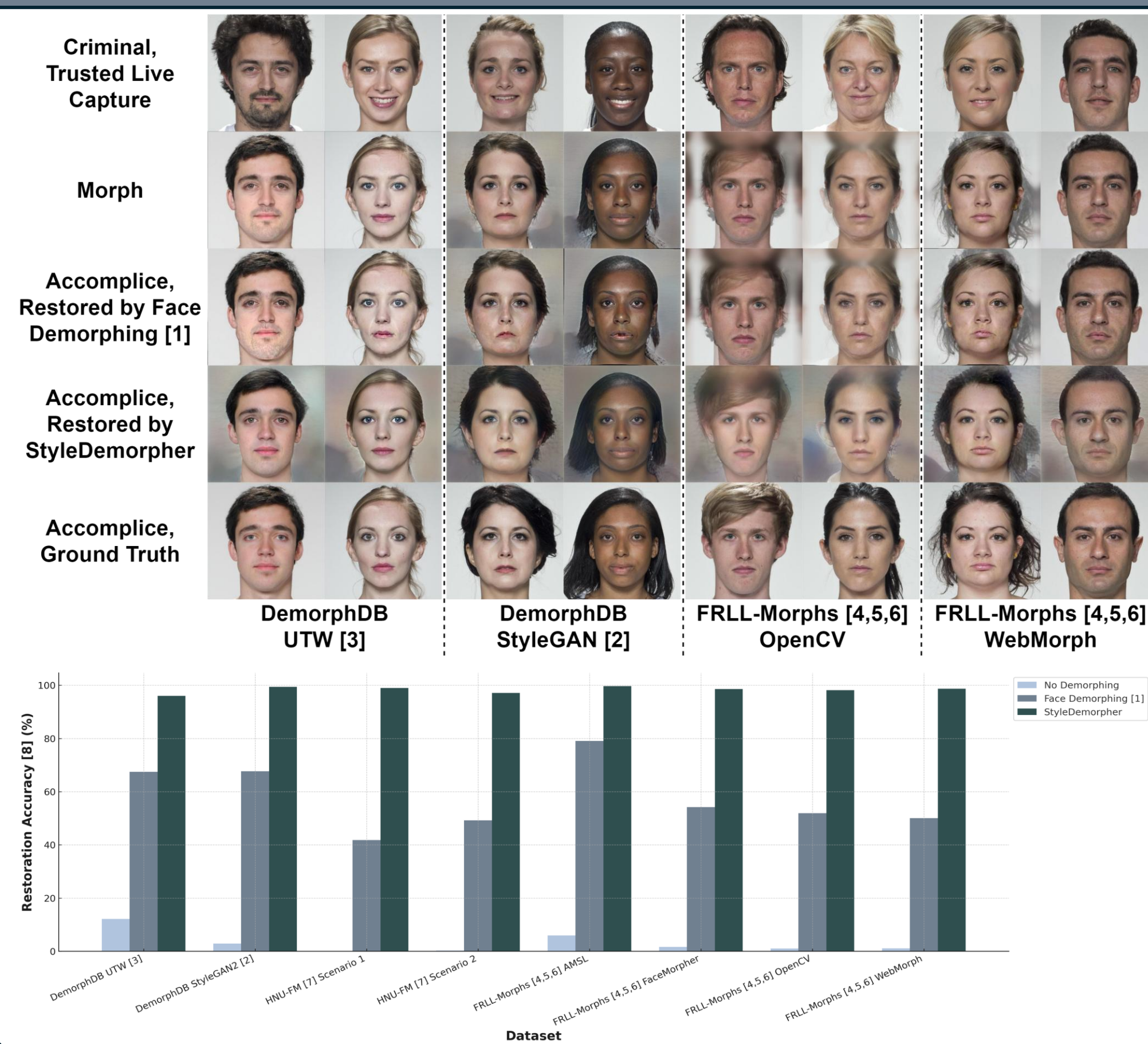- Trained on over 100,000 facial images.
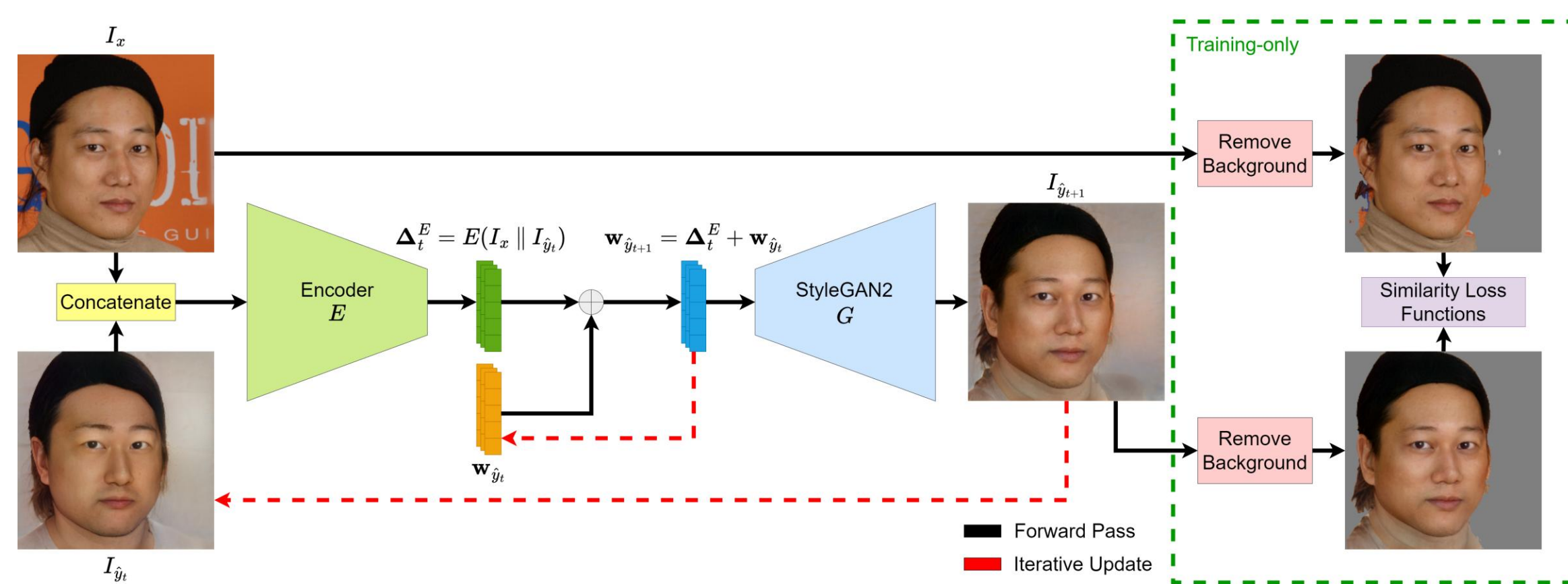


### StyleDemorpher Framework

- Face demorphing network that reconstructs the accomplice's identity.
- Inputs: Morphed document image + trusted live capture.
- Initialized with ReStyle-ID weights, leveraging prior knowledge of image-latent space relationships.
- Trained on DemorphDB, a newly developed dataset for face demorphing.
- Ignores background information similar to ReStyle-ID.
- Uses inverse identity loss to remove traces of the criminal's identity.



## Results



Criminal, Trusted Live Capture — Morph — Accomplice, Restored by Face Demorphing [1] — Accomplice, Restored by StyleDemorpher — Accomplice, Ground Truth

DemorphDB UTW [3] — DemorphDB StyleGAN [2] — FRLL-Morphs [4,5,6] OpenCV — FRLL-Morphs [4,5,6] WebMorph



## Conclusion & Future Work

StyleDemorpher accurately reconstructs accomplices in high resolution using StyleGAN2's [2] latent space. It outperforms state-of-the-art demorphing methods and generalizes well to unseen identities and morphing techniques.

Future work will focus on mitigating its impact on genuine (non-morphed) travel documents, as it is currently trained only on morphed images.

## References

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