Putting People in Their Place: Affordance-Aware Human Insertion in Scenes

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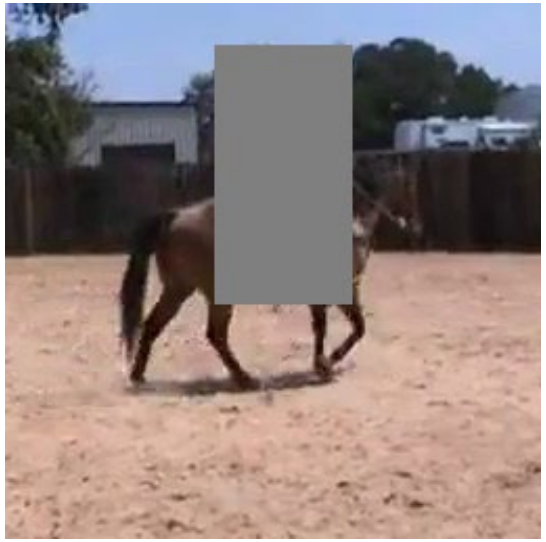
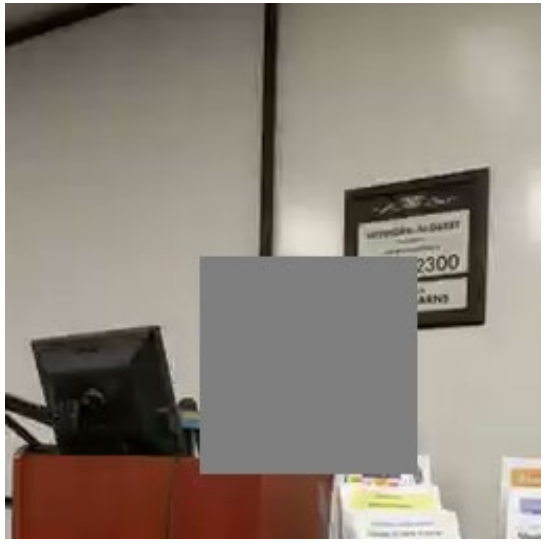
Adobe

BAIR BERKELEY ARTIFICIAL INTELLIGENCE RESEARCH

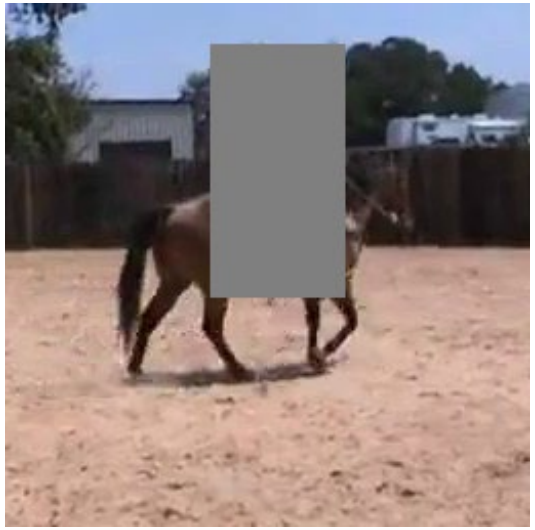
Stanford University

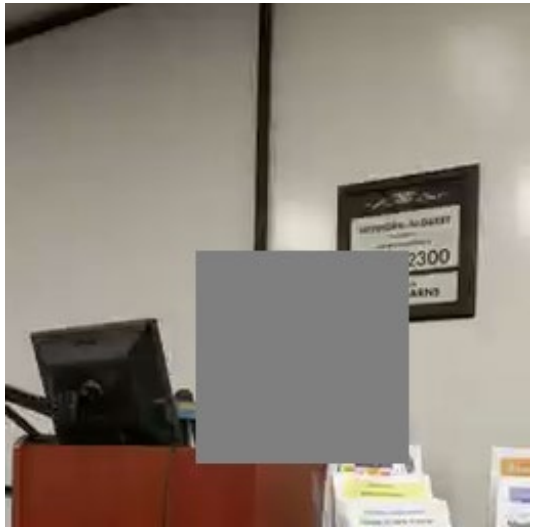

VivaVideo






VivaVideo

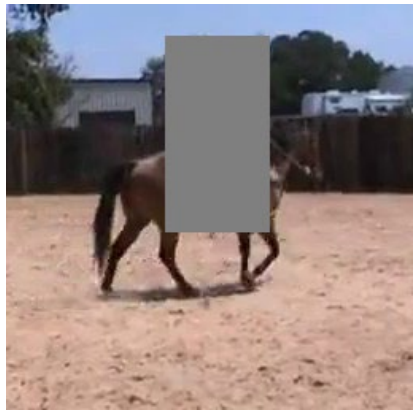
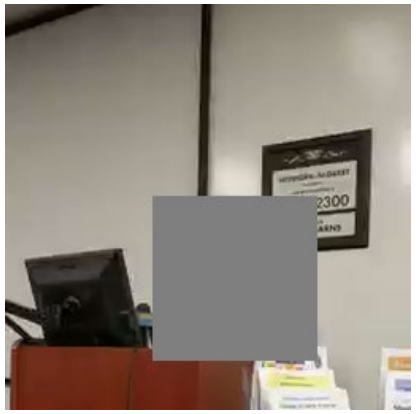




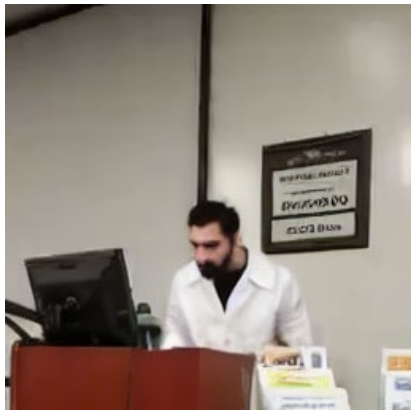

VivaVideo

Input Scene

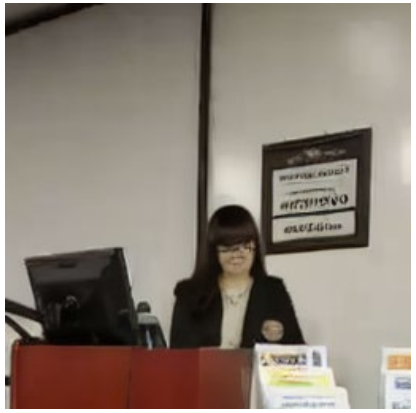
Input Person

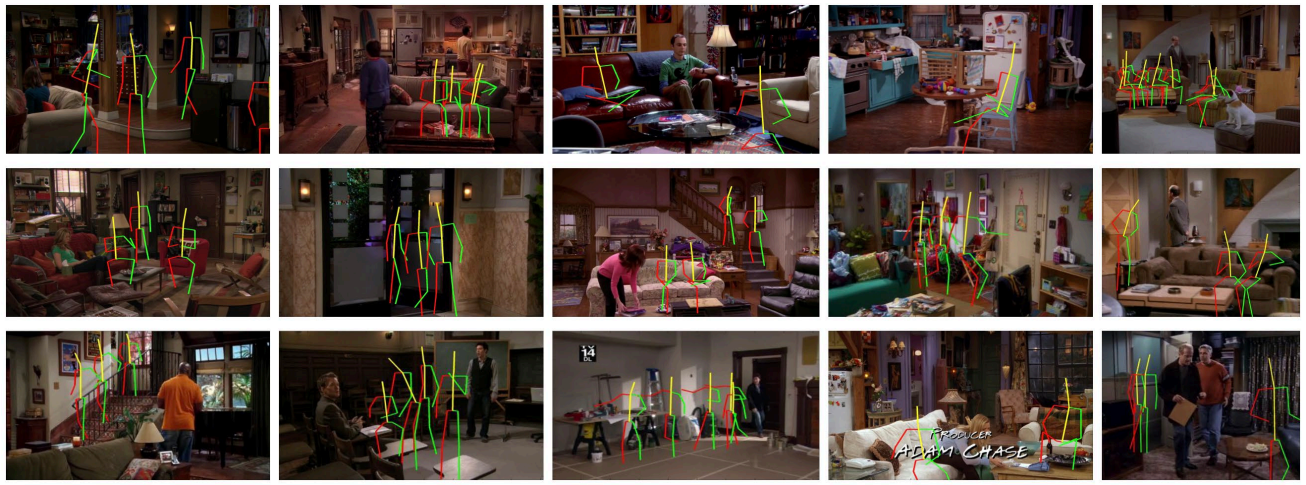


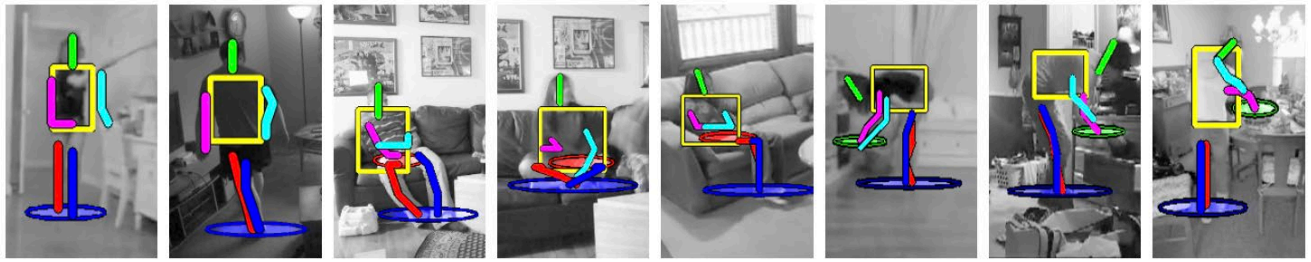


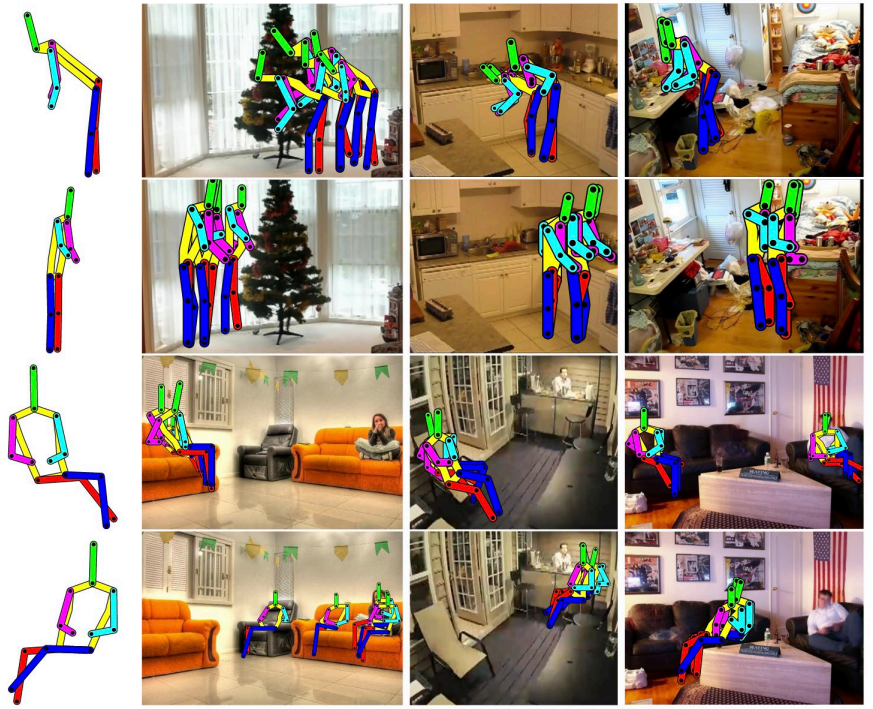




Prior Work on Affordance Learning



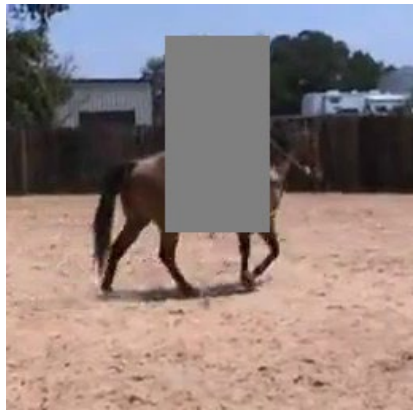
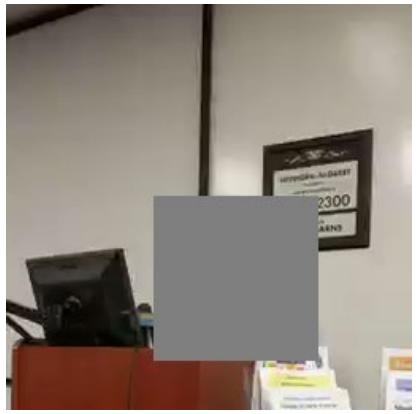
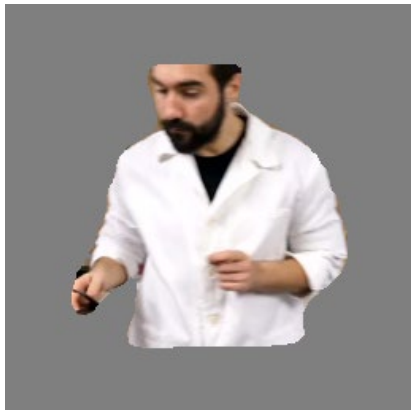


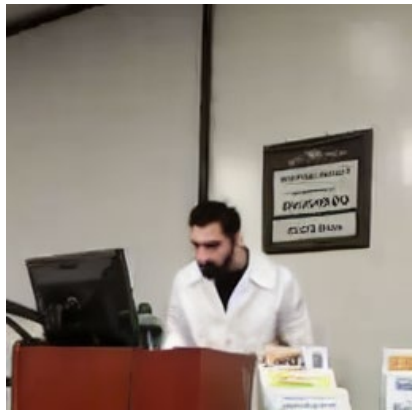


People Watching: Human Actions as a Cue for Single View Geometry. Fouhey et al.
Scene semantics from long-term observation of people. Delaitre et al.
Binge Watching: Scaling Affordance Learning from Sitcoms. Wang et a.

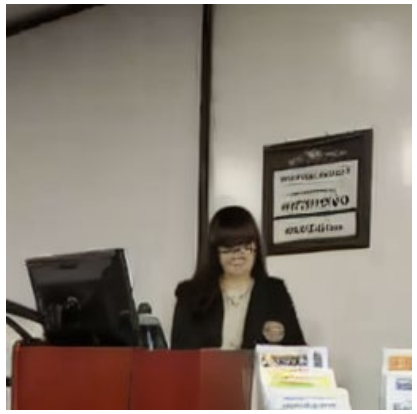
Input Scene

Input Person

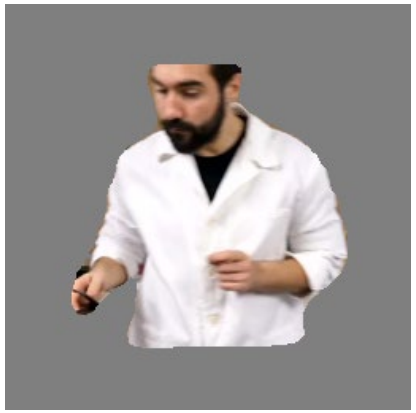
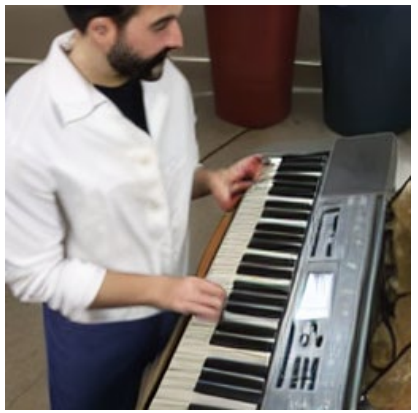




Input Scene

Input Person







Input Scene

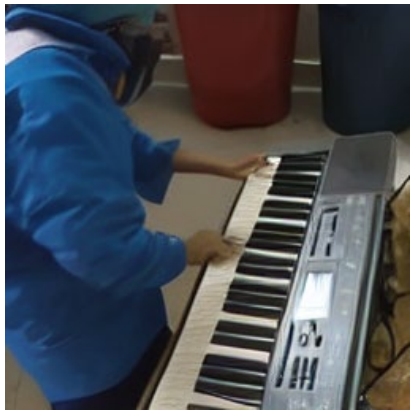
Input Person







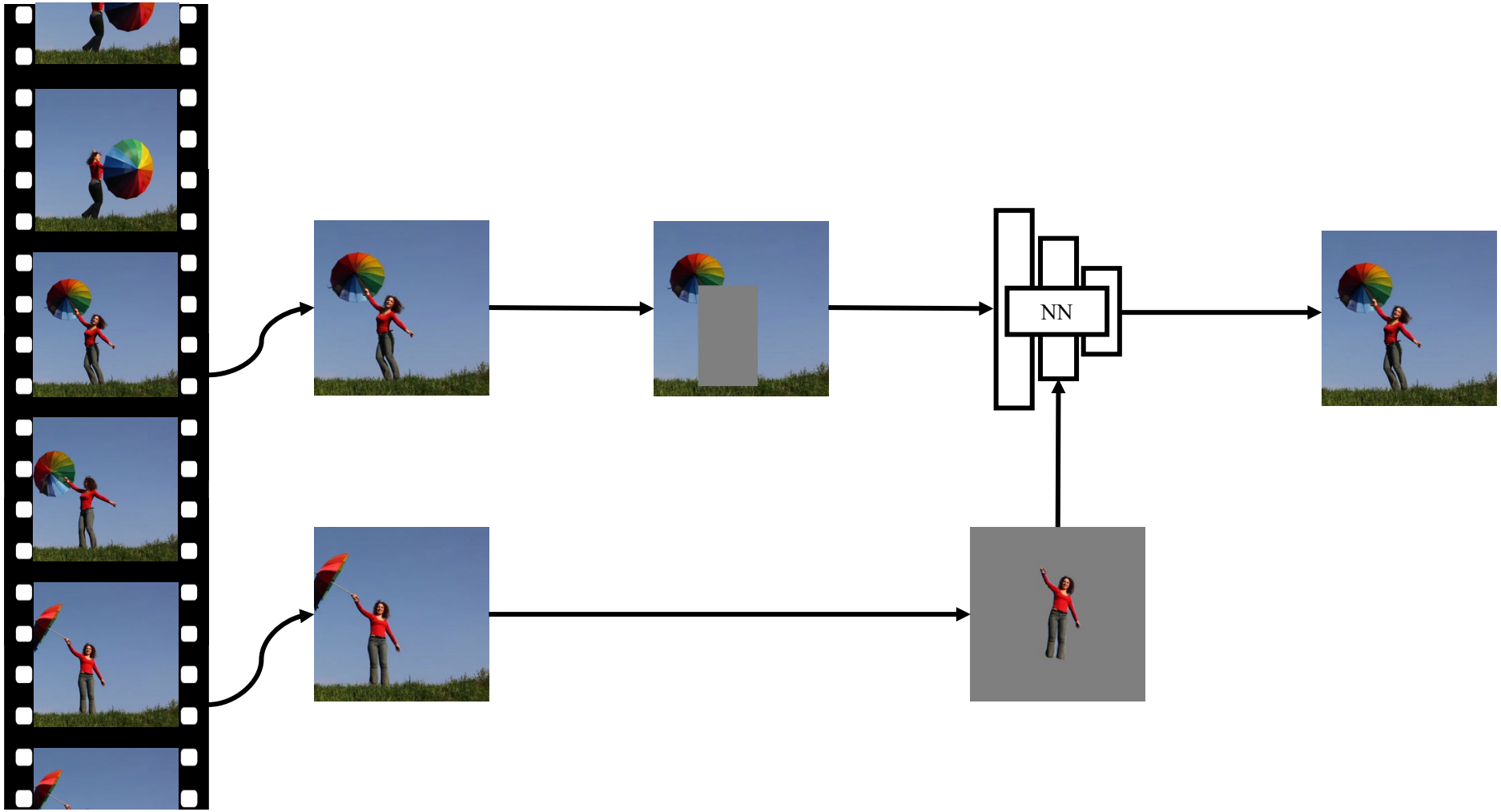




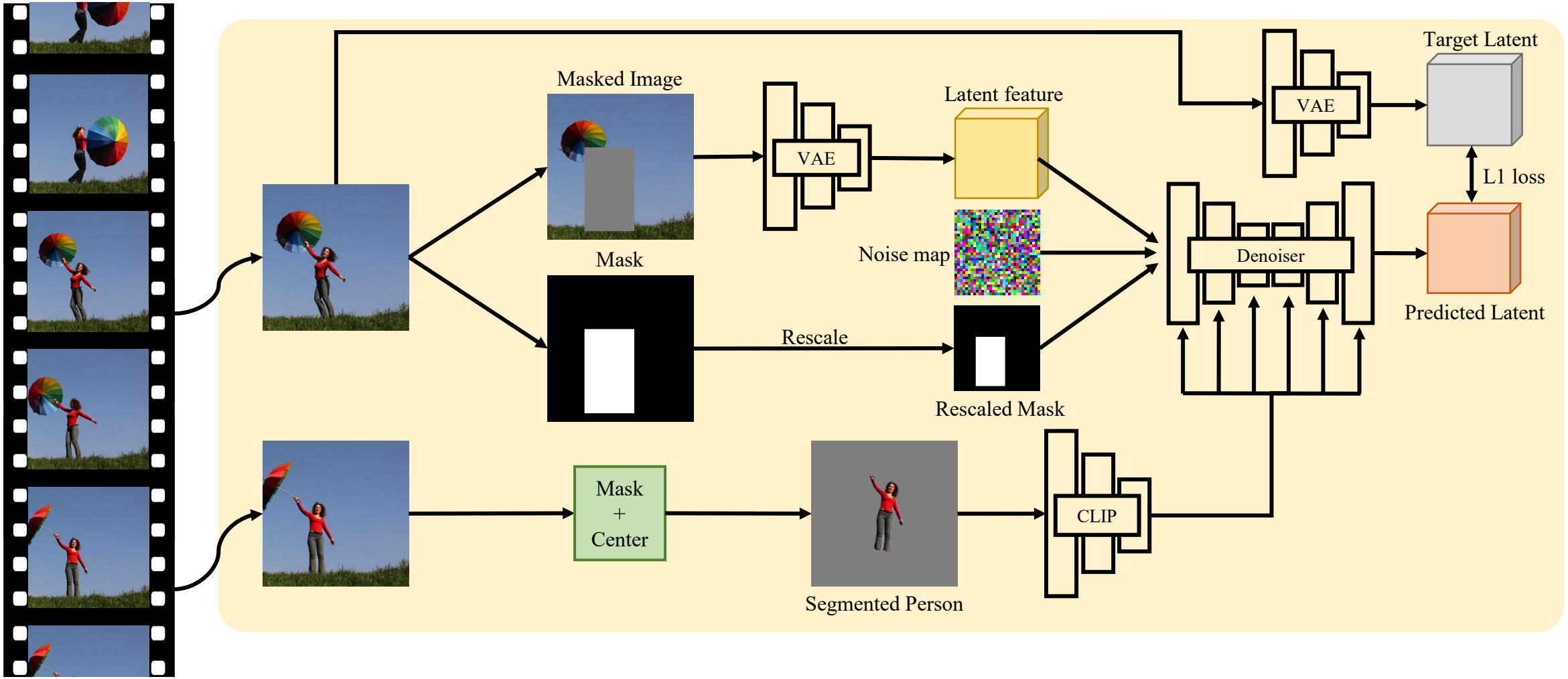
Input Scene

Input Person

Core Idea



Learning Architecture

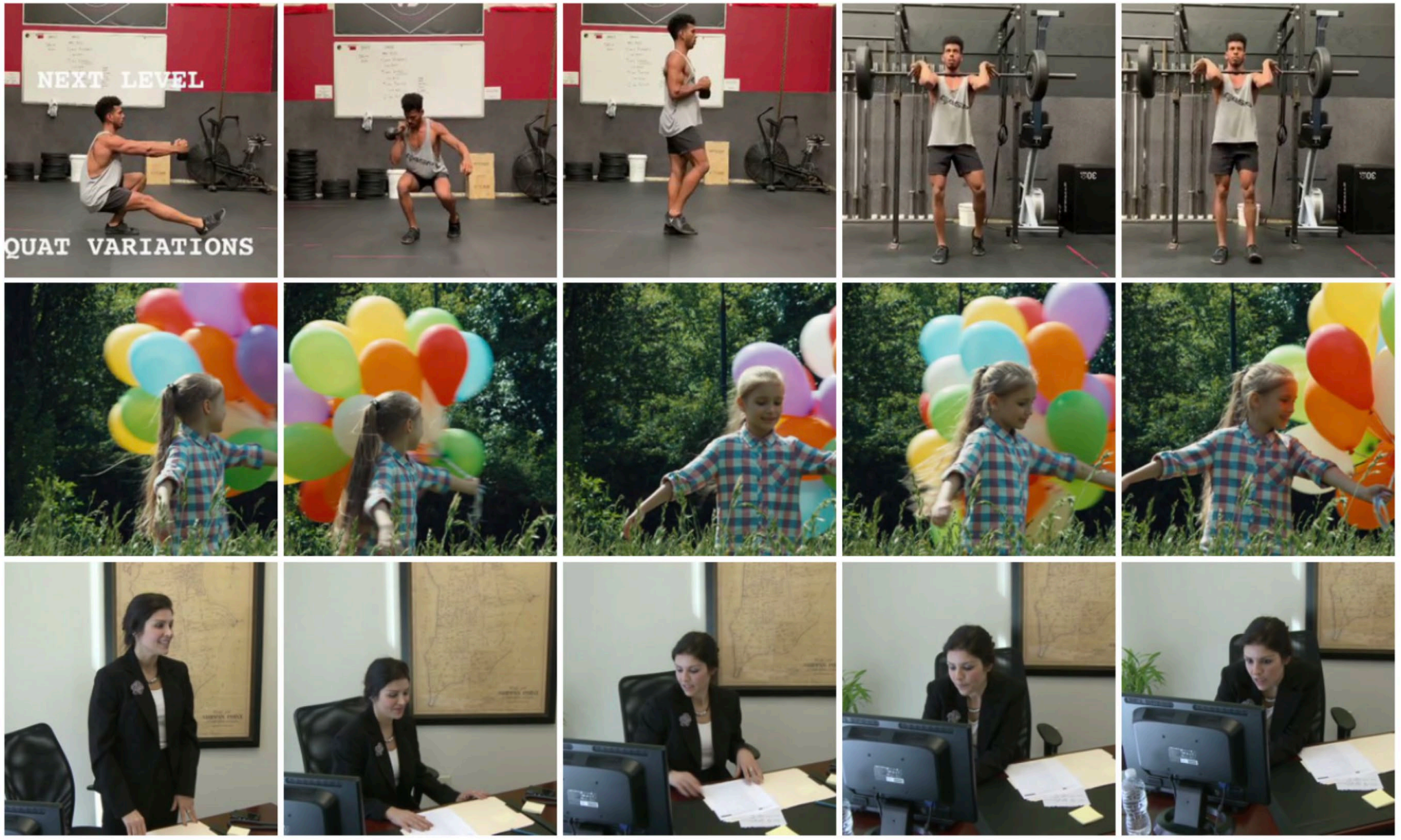


Dataset

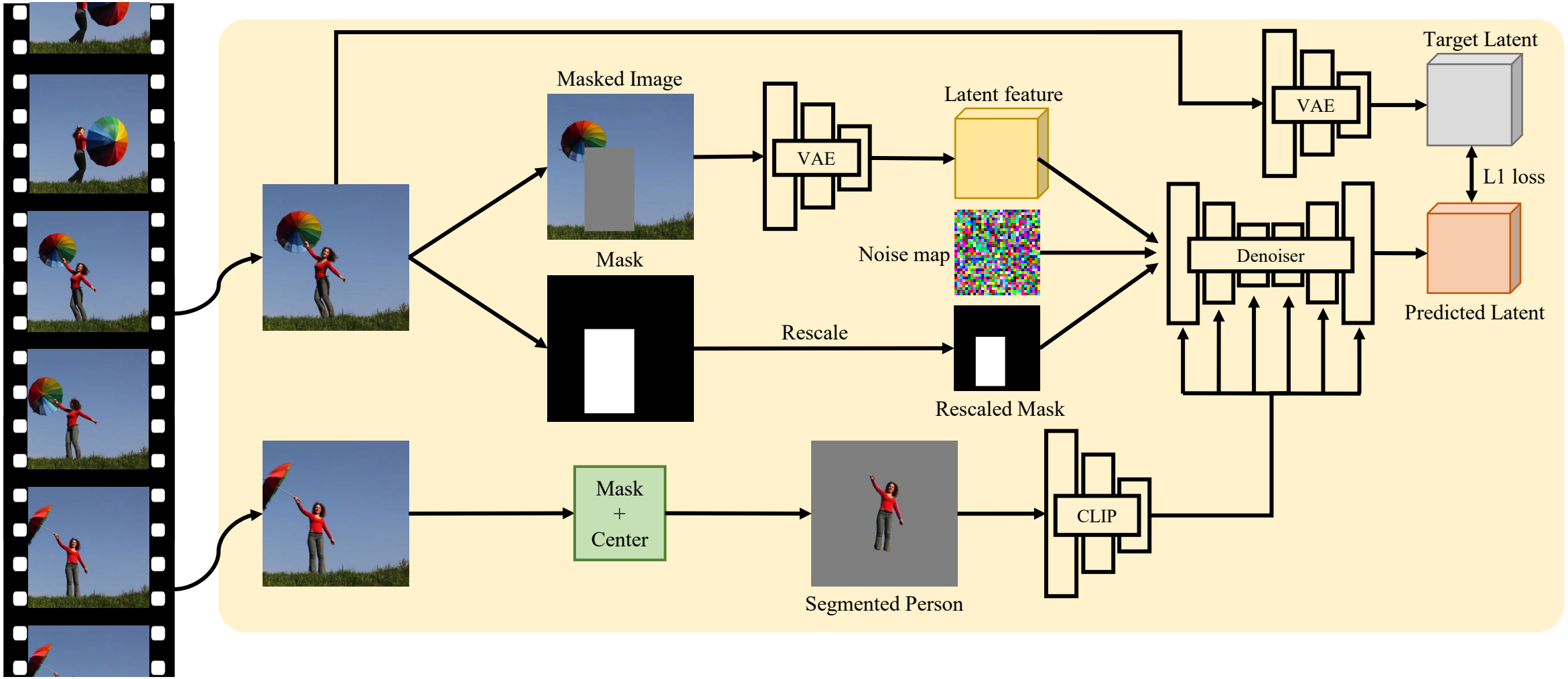
- Prepared a dataset of humans interacting with diverse scenes.
- Inspired by prior work, we search for 256 x 256 spatiotemporal segments with human presence.
- Our data source includes public computer vision datasets and proprietary data.
- Starting with 13 million videos, we ended up 2.4 million clips of interest after processing.

Hallucinating Pose-Compatible Scenes. Brooks et al.

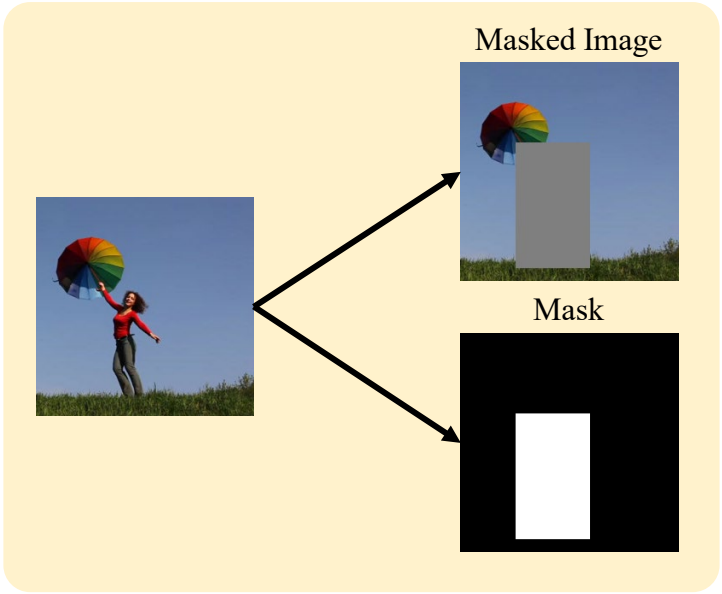
Dataset

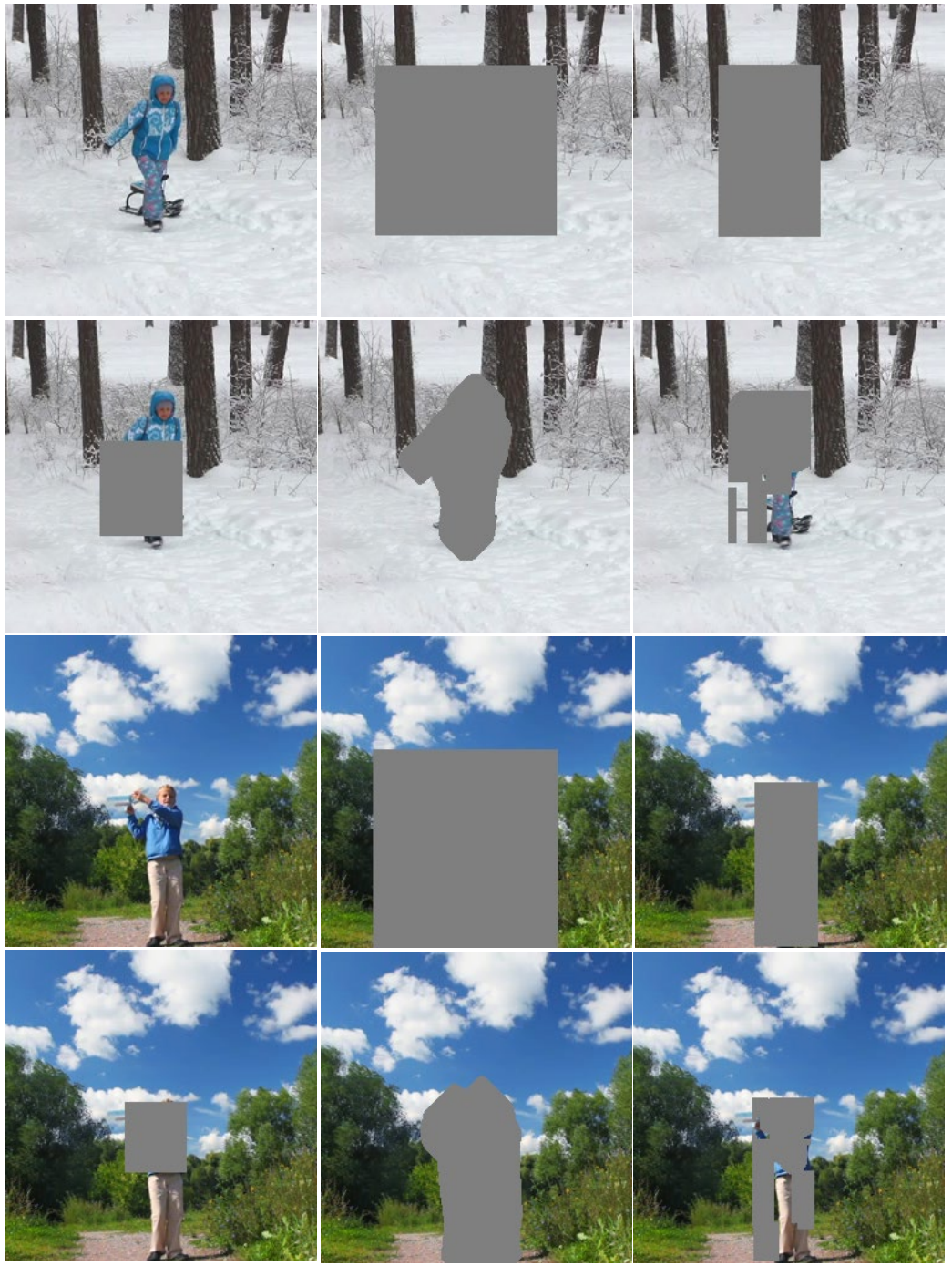


Learning Architecture

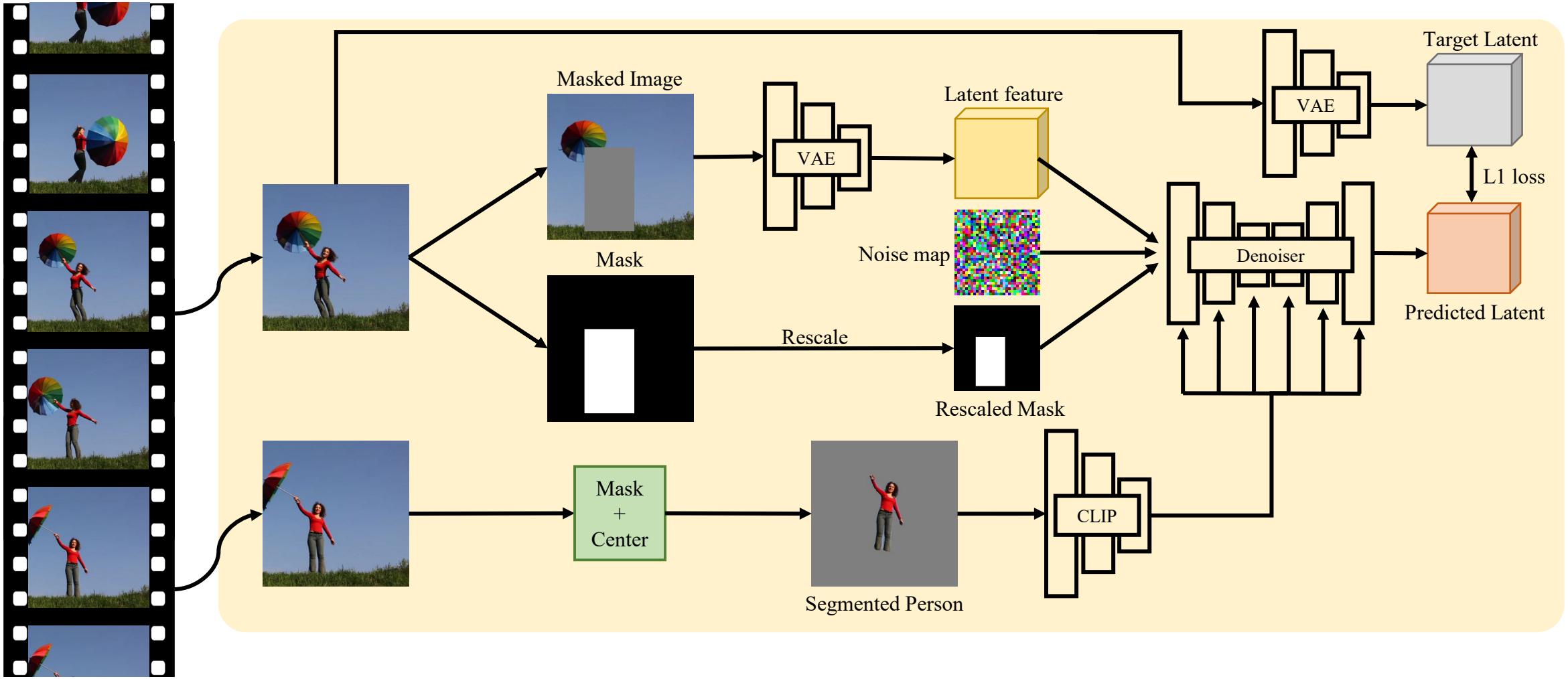


Masking strategy

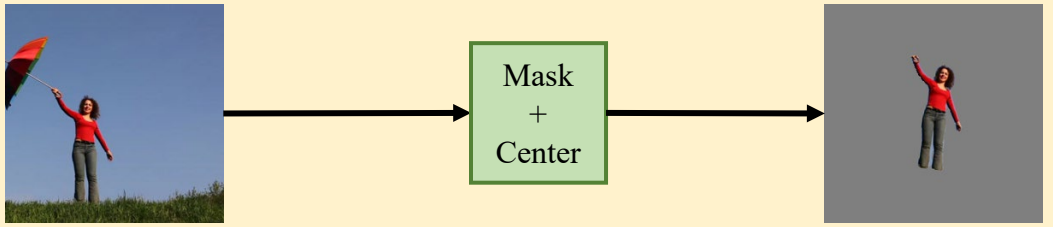




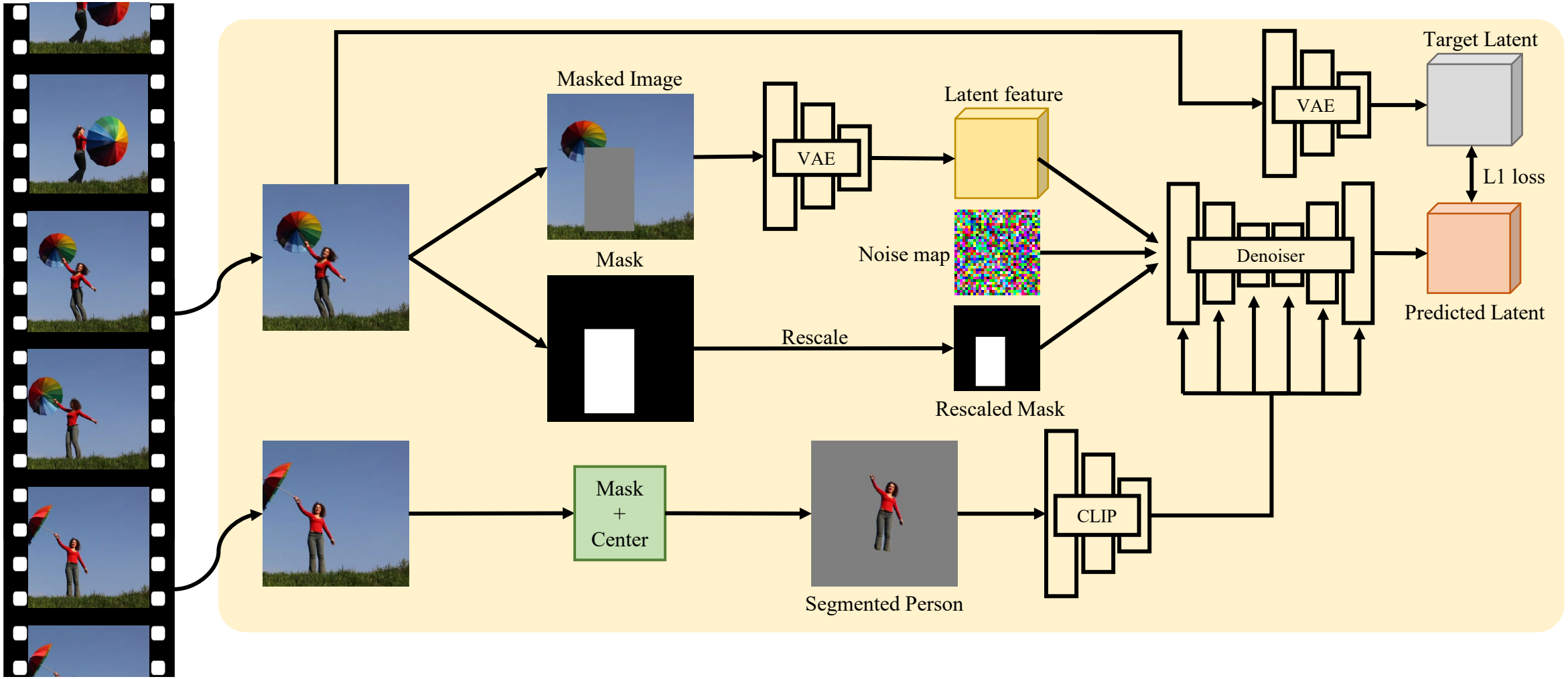
Learning Architecture



Reference person

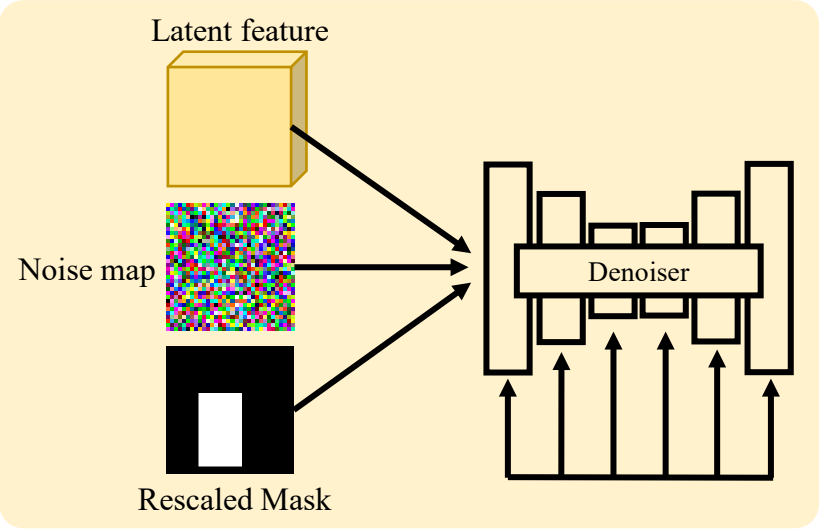


Learning Architecture

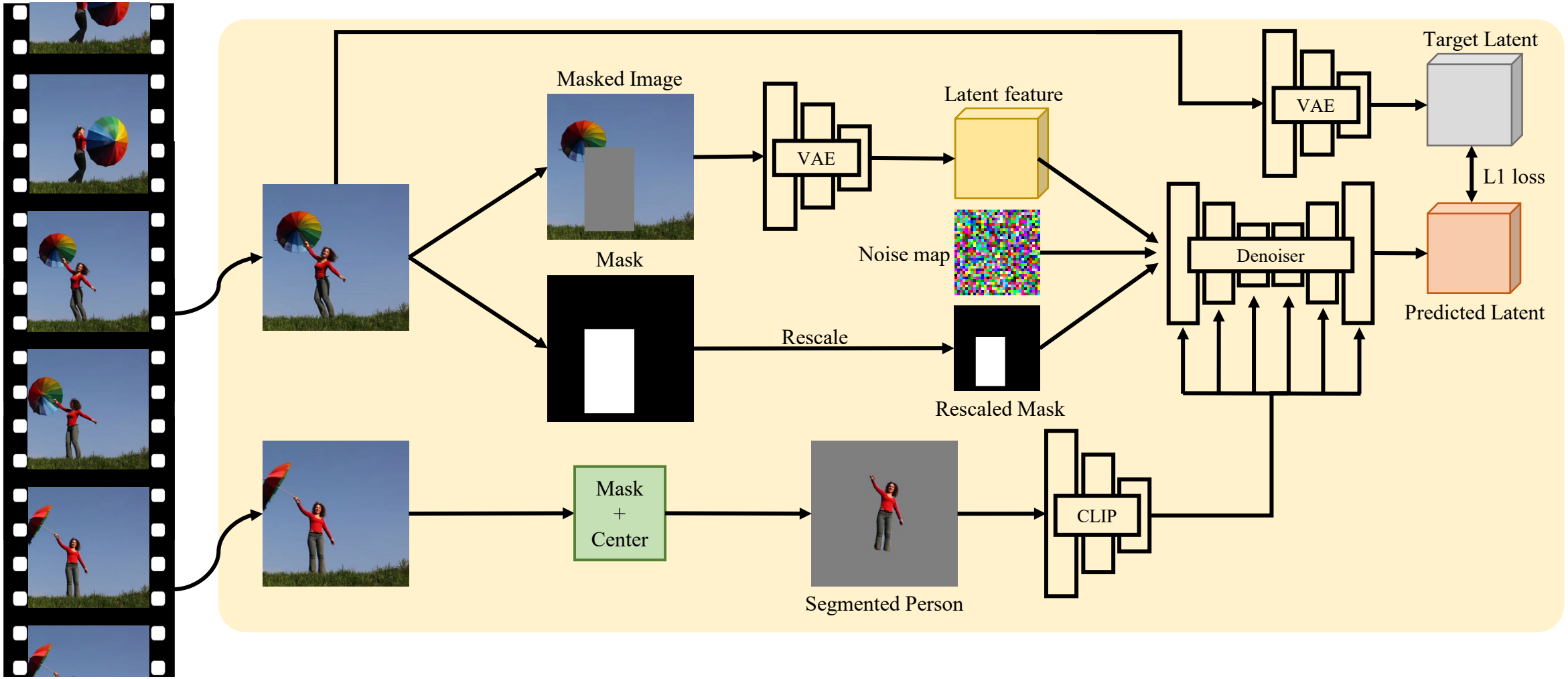


Denoising U-Net

- Follows standard distributed training procedures.
- Input scene passed through concatenation.
- Refer person passed through cross-attention
- Classifier-free guidance by dropping both the conditioning.



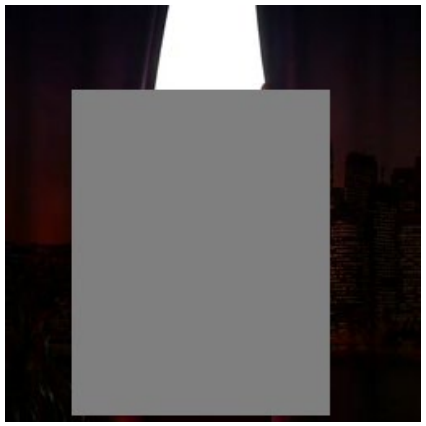
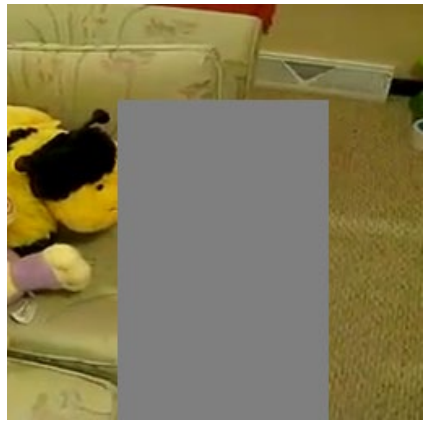
Learning Architecture

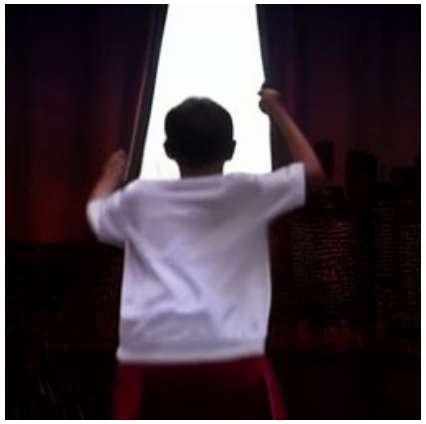
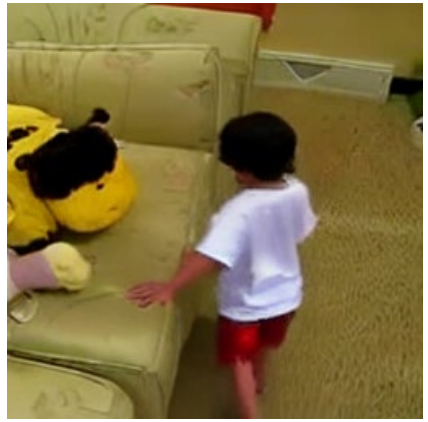


Person Conditioned Insertions

Scenes

Input

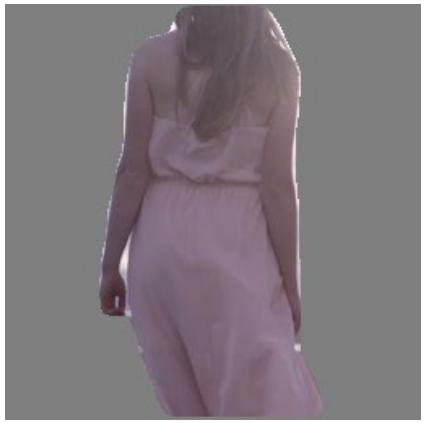





Samples

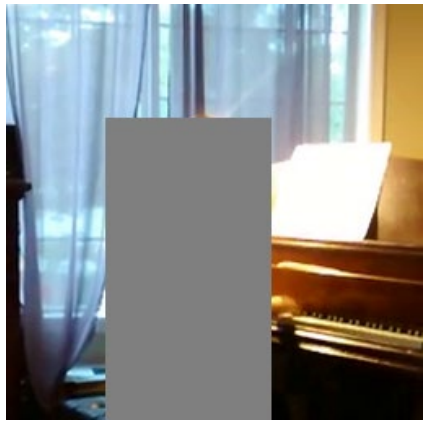
Person Conditioned Insertions

Scenes

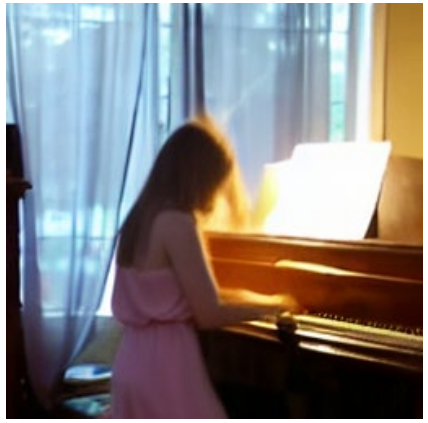


Input










Samples

Person Conditioned Insertions

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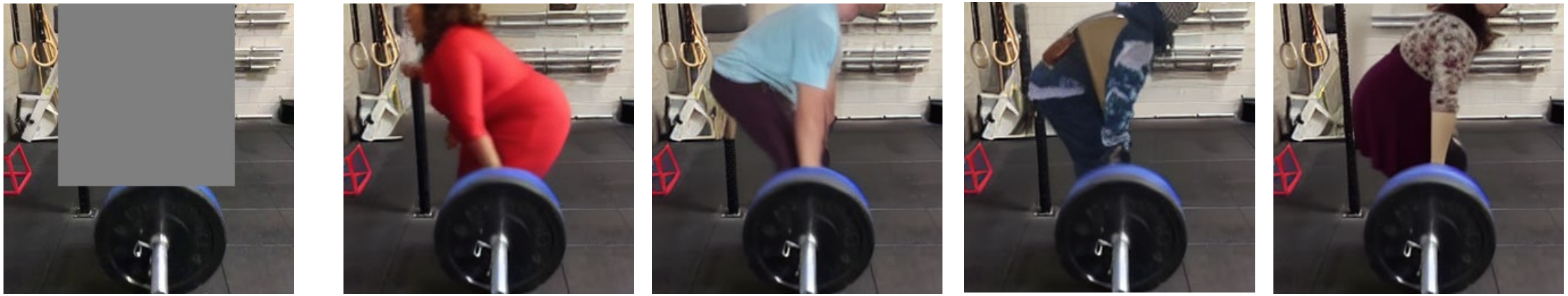

Input

Samples

Person Conditioned Insertions

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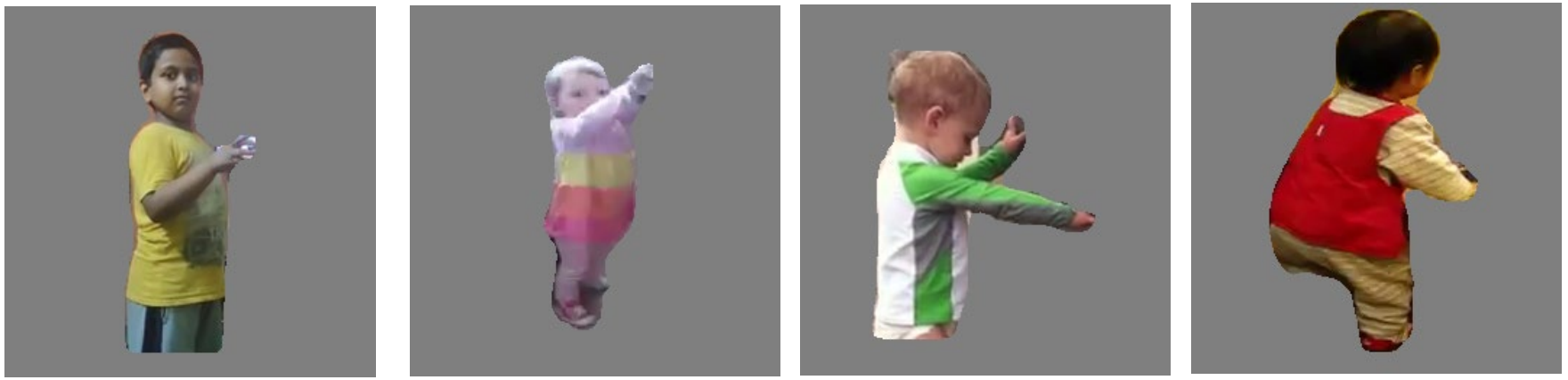

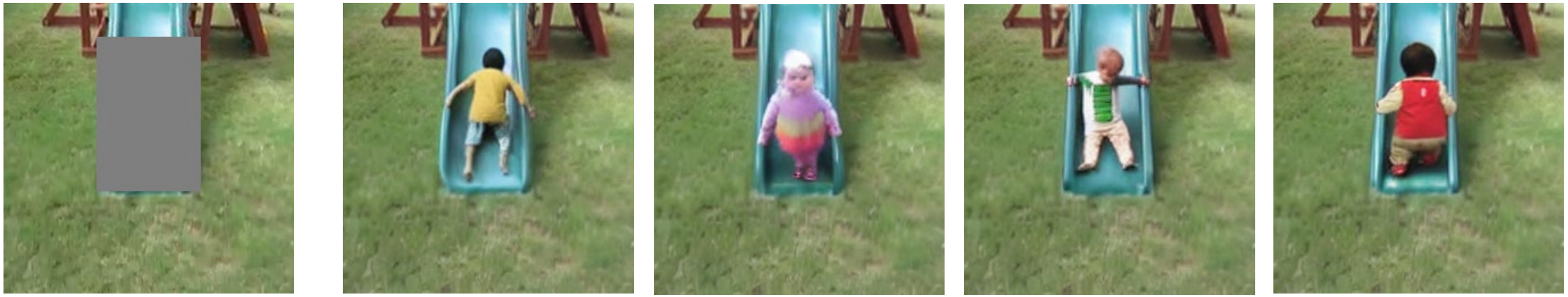

Input

Samples

Person Conditioned Insertions

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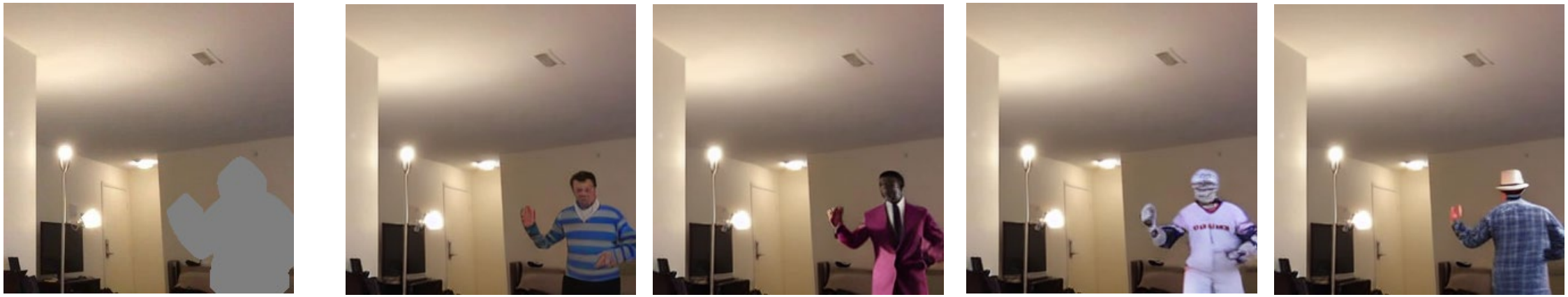


Input

Samples

Architecture ablations - Data

Method	FID	PCKh
Image (w/o aug)	13.174	8.321
Image (w/ aug)	13.008	10.660
Video (w/o aug)	12.103	15.797
Video (w/ aug)	10.078	17.602

- Video data is **crucial** for our task.
- Using image-only data even with augmentations doesn’t work.

Architecture ablations - Scaling

Method	FID	PCKh
Small (400M, scratch)	12.366	15.095
Large (scratch)	11.232	15.873
Large (fine-tune)	10.078	17.602

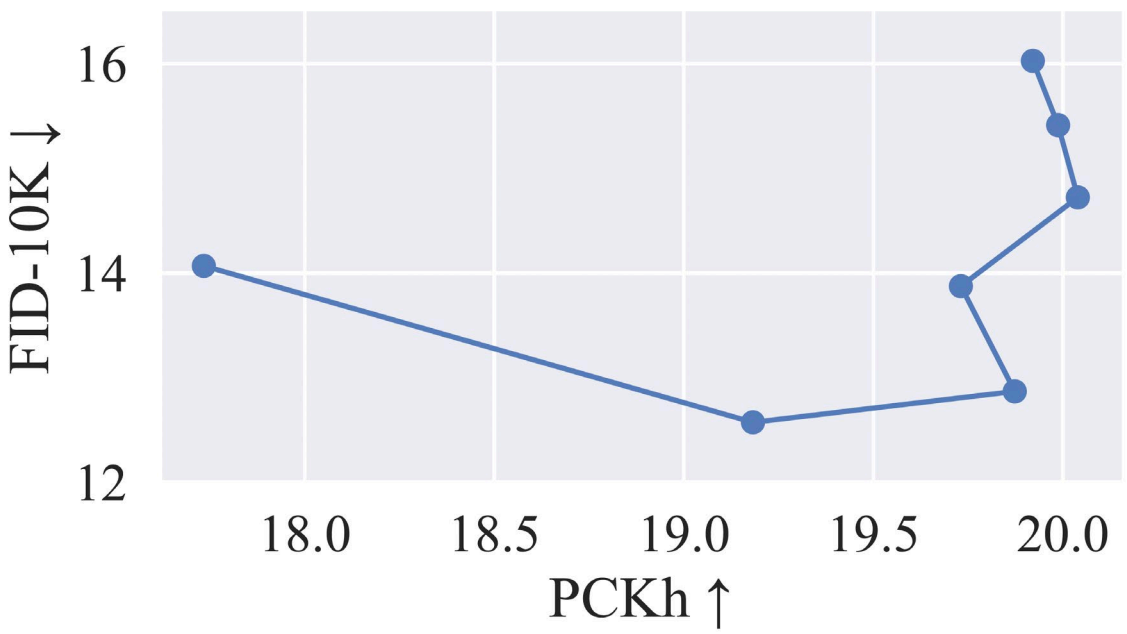
- Smaller scale models do not perform as well.
- Initialization with Stable-Diffusion weights help.

Person Hallucinations

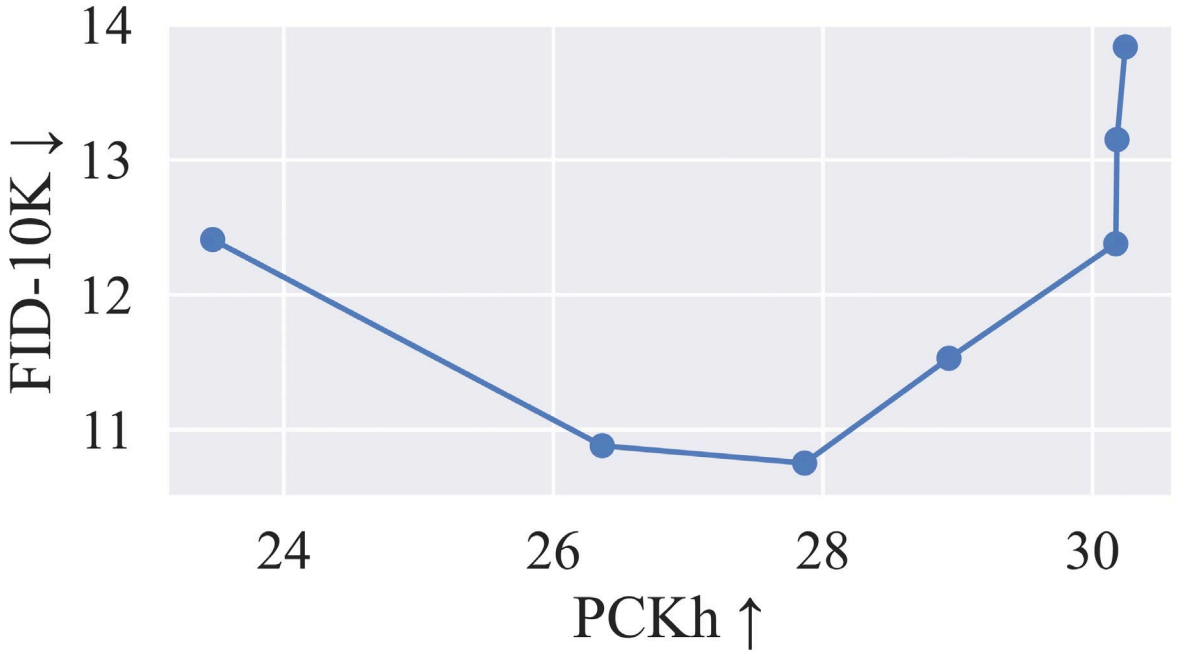
Ground-Truth Input Samples

Classifier-Free Guidance

Effect of increasing CFG guidance scale.
Evaluated at scale values [1.0, 1.5, 2.0, 3.0, 4.0, 5.0, 6.0]

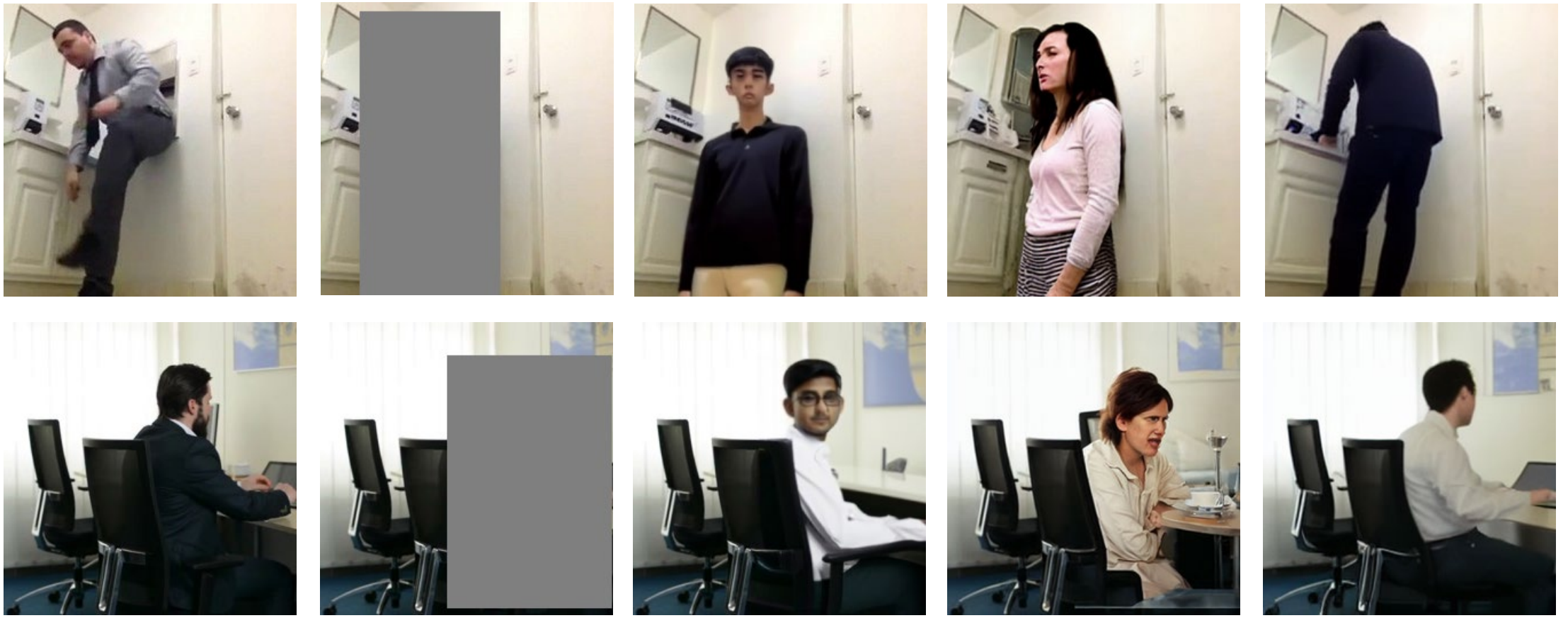


Person Conditioned



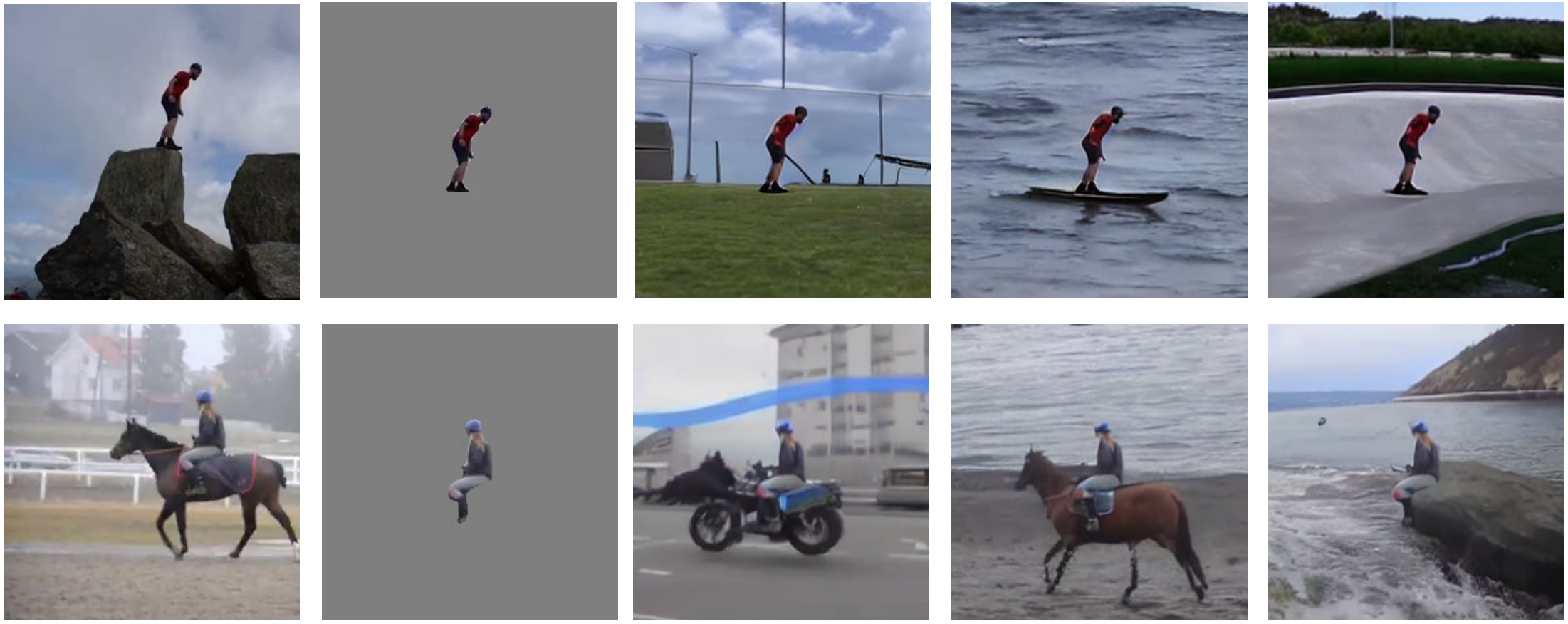
Person Hallucination

Person Hallucinations - Baselines



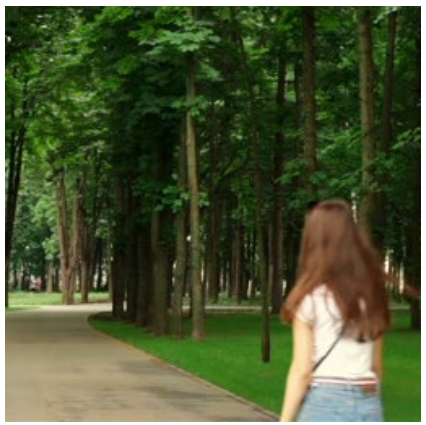
Ground-Truth | Input | DALL-E 2 | Stable-Diffusion v1.5 | Ours

Constrained Scene Hallucination

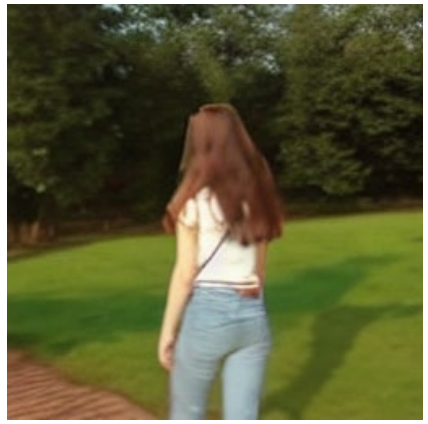


Ground-Truth Input Samples

Constrained Scene Hallucination - Baselines







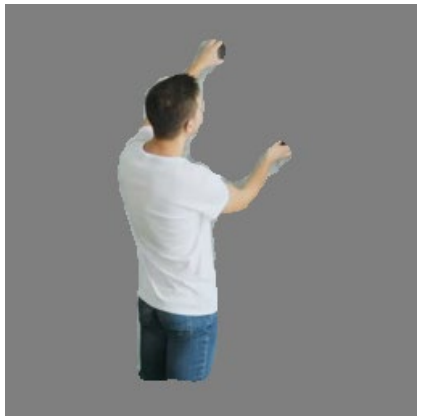



Ground-Truth | Input | DALL-E 2 | Stable-Diffusion v1.5 | Ours

Partial Body Completions

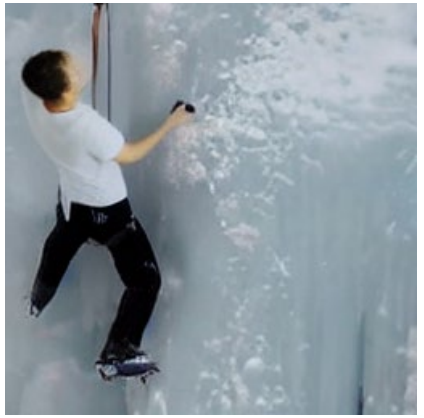
Reference









Input

Samples

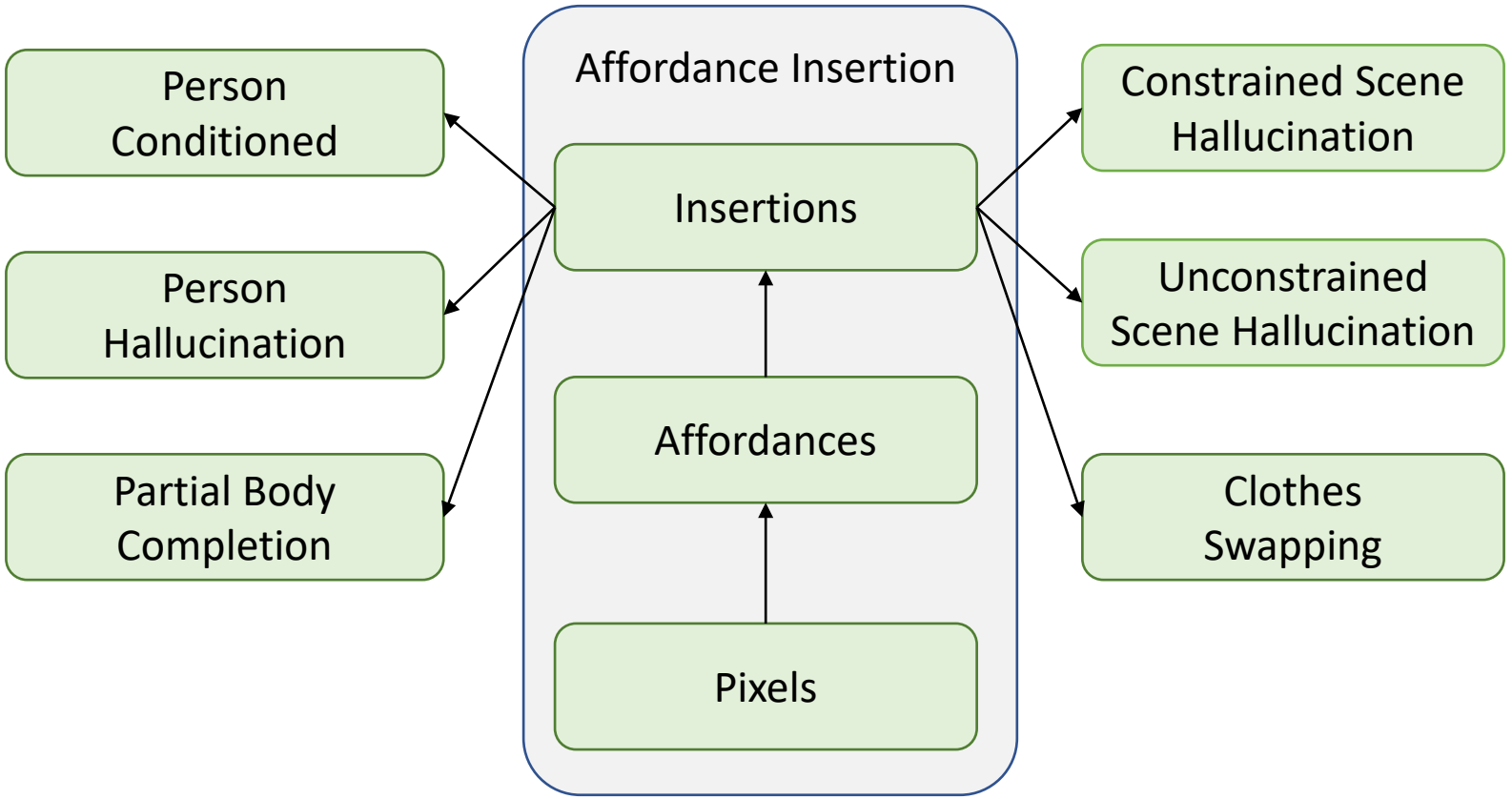
Cloth Swapping

Reference clothes

Input

Samples

In summary



Project Page: https://sumith1896.github.io/affordance-insertion