KAIST RCV ROBOTICS AND COMPUTER VISION LAB

2018 ChaLearn Looking at People Challenge - Track 2. Video Decaptioning

DVDNet

Deep Blind Video Decaptioning with 3D-2D Gated Convolutions

Dahun Kim*, Sanghyun Woo*, Joonyoung Lee, In So Kweon

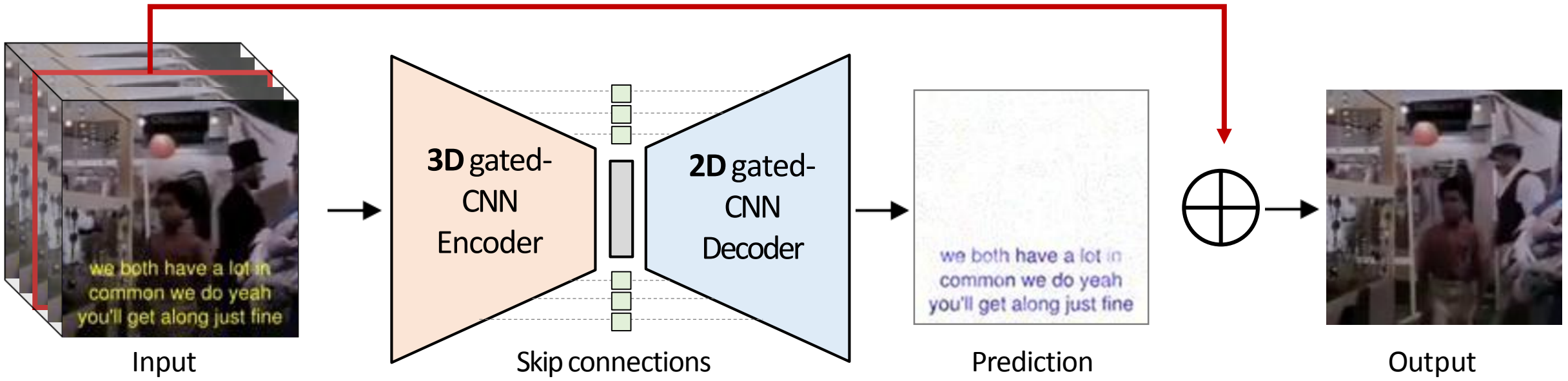
Our Problem

Remove text overlays in video

Need to consider two important points:

1. Video : Sequence of frames)
2. Blind : No inpainting mask)

Model Overview



Two important points :

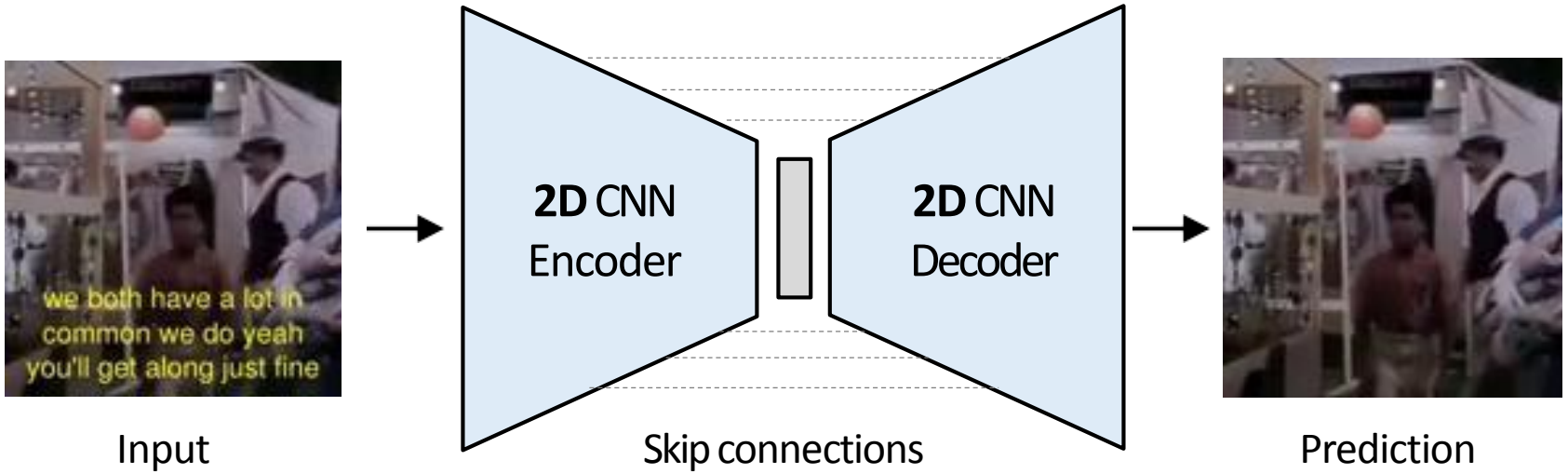
- Video : Sequence of frames
- Blind : No inpainting mask

- **3D-2D U-net**
- **Residual learning**
- **+ Gated convolution**

Vanilla 2D U-Net*

Frame-by-frame operation

- Spatial context



Two important points :

- Video : Sequence of frames
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- **Scene dynamics**

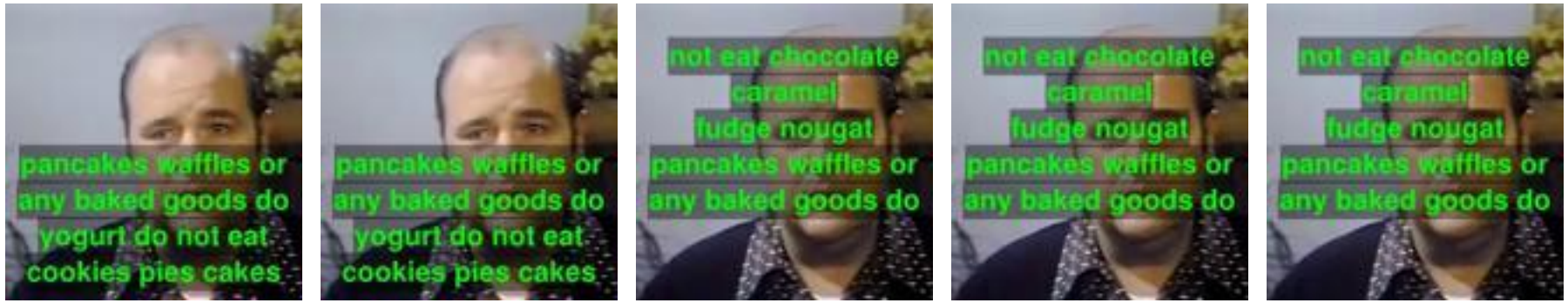
* Ronneberger, O.et al. “U-net: Convolutional networks for biomedical image segmentation.” MICCAI 2015.

Input : Multiple frames

Scene dynamics

- Aggregate hints from **spatio-temporal** neighborhoods

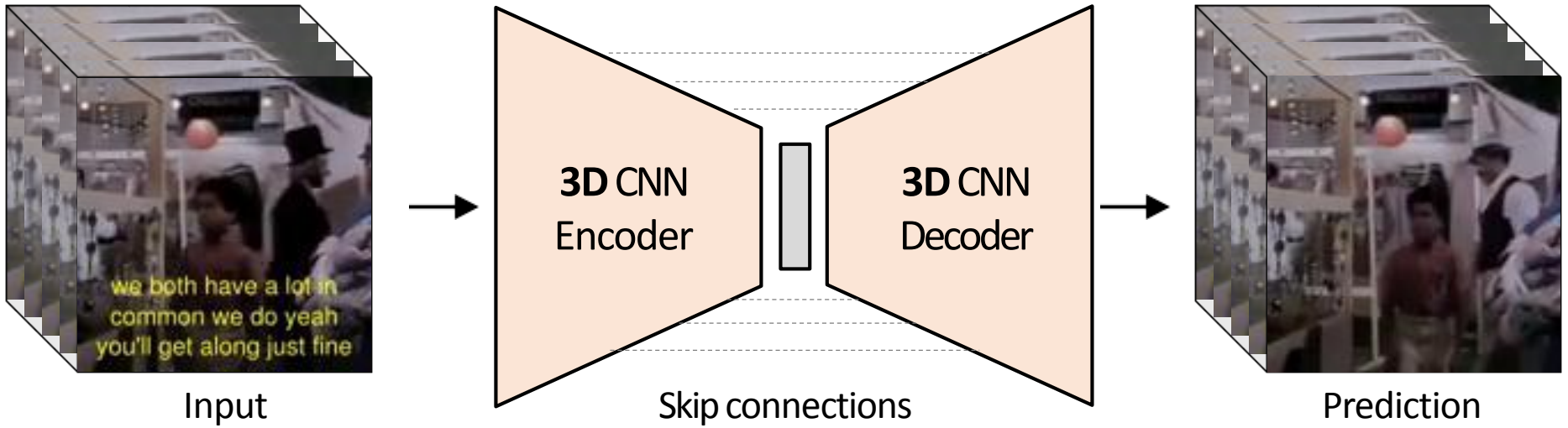
→ *Object movements*



→ *Subtitle changes*

Vanilla 3D U-Net*

Multiple frame prediction



- Hard problem
- Heavy
- Not uniform prediction

* C¸ ic¸ek, O¨ .et al. “3d u-net: learning dense volumetric segmentation from sparse annotation.” MICCAI 2016.

Output : Single frame

Focus on a single frame

- Aggregate hints from **lagging and leading frames.**

Lagging frames *Leading frames*

3D-2D U-Net

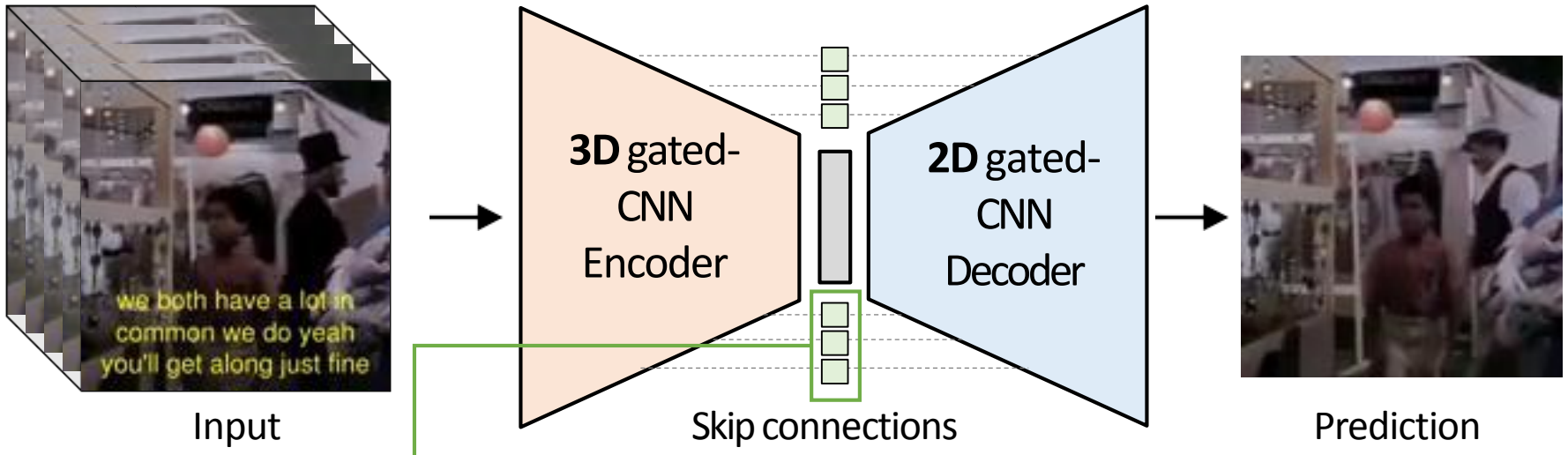
- Easy problem
- Light-weight
- Temporal view range

Output

Center frame

3D-2D U-Net architecture

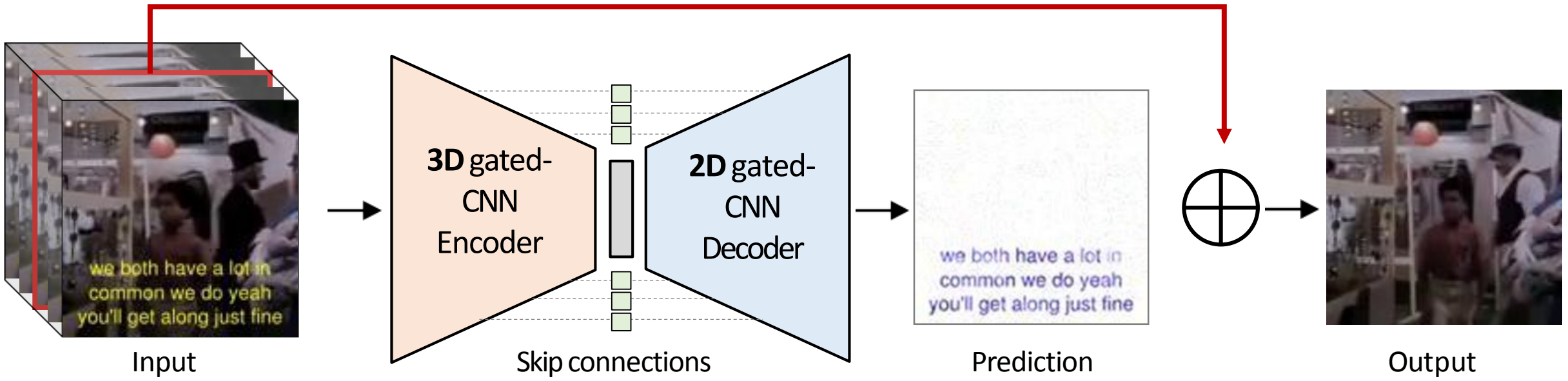
Focus on a single frame



- 3D convolutions to ***flatten*** the encoder features ***into one frame***.

→ <u>to match the shape and concatenate.</u>

Residual Learning



→ Implicitly knows the inpainting mask

Two important points :

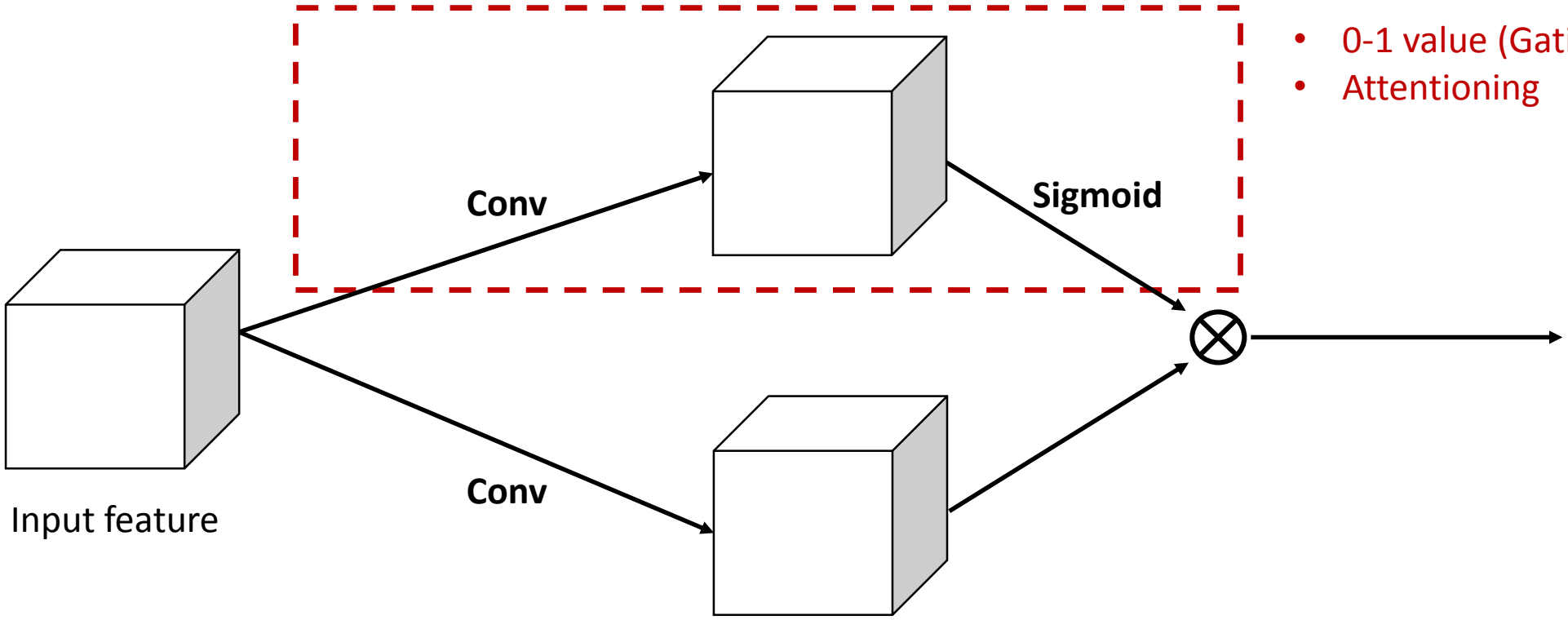
- Video : Sequence of frames
- Blind : No inpainting mask

- **Residual learning**
  - *Not touching good pixels*
  - *Focus on the corrupted regions*

+ Attention

Gated Convolution*

$$Gate = \sigma(W_g \otimes Input)$$
$$Feature = \phi(W_f \otimes Input)$$
$$Out = Feature \odot Gate$$

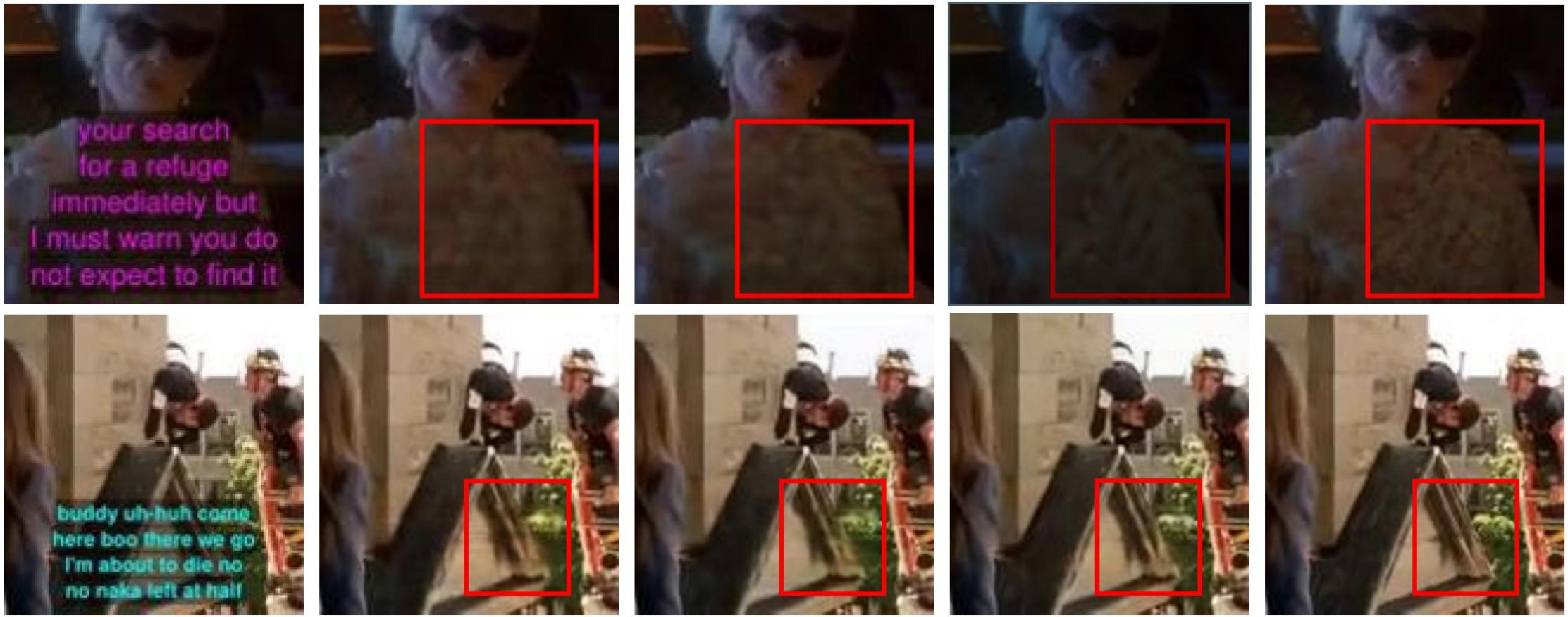


- 0-1 value (Gating)
- Attentioning

* Yu, J. et al. “Free-form image inpainting with gated convolution”. arXiv preprint arXiv:1806.03589.

Loss Function

L1 + gradient L1 + SSIM loss



(a) input (b) L1 (c) L1 + grad.L1 (d) L1+grad.L1+SSIM (e) target(GT)

Quantative Results

User	MSE	PSNR	DSSIM
KAIST-RCV	0.0011	33.3527	0.0404
ucs	0.0011	33.0052	0.041
hcilab	0.0012	33.0228	0.0424
anubhap93	0.0012	32.0021	0.0499
arnavkj95	0.0012	32.1713	0.0482
Baseline	0.0022	30.1856	0.0613

Qualitative Results

(a)

(b)

(c)

(d)

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