Blind Removal of Facial Foreign Shadows

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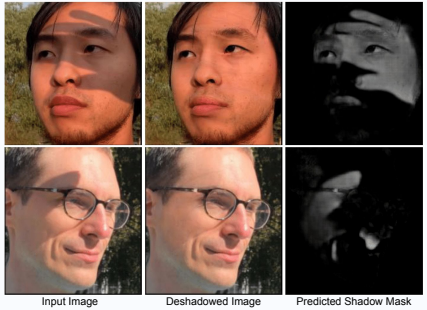
Motivation

- Self-shadow removal is a well studied problem, but foreign shadow removal is understudied.
- Outside of images, shadow removal in videos lacks temporal consistency.
- There are very limited options for evaluating foreign shadow removal and segmentation on in-the-wild images.

Examples of images with foreign shadows cast by external objects such as hands, paper, and pens.

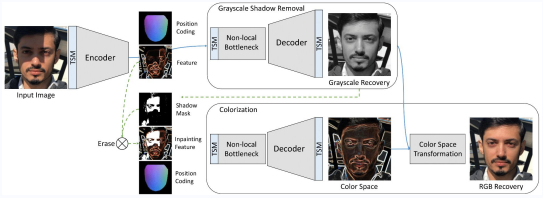
Proposed Solution

- We propose a foreign shadow removal method that decomposes the problem into grayscale shadow removal and colorization.
- We propose a temporal sharing module (TSM) that improves video shadow removal consistency and face symmetry.
- We collect a new in-the-wild database of subjects with diverse foreign shadows called Shadow Faces in the Wild (SFW), which can be used to evaluate shadow segmentation and removal.

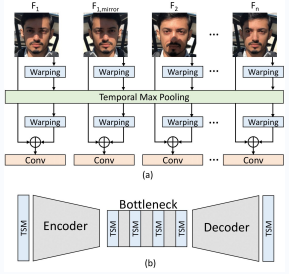


Input Image | Deshadowed Image | Predicted Shadow Mask

Model Architecture



Temporal Sharing Module (TSM)



- Our temporal sharing module (TSM) uses temporal max pooling to share illumination information across video frames.
- TSM improves temporal consistency of video shadow removal and enforces face symmetry in single image settings.

Shadow Faces in the Wild (SFW) Database

- SFW database contains 280 videos of 20 subjects in the wild with diverse foreign shadows.
- Capture settings include indoors, outdoors while standing, outdoors while walking, outdoors under trees, and driving.
- 440 frames are annotated for shadow segmentation evaluation.

Shadow Removal on UCB Test Set

Removal Model	PSNR	SSIM
Input Image	19.671	0.766
Guo *et al.*[17]	15.939	0.593
Hu *et al.*[22]	18.956	0.699
Cun *et al.*[8]	19.386	0.722
Zhang *et al.*[55]	23.816	0.782
RGB (Ours)	23.005	0.854
GS+C (Ours)	**23.829**	**0.866**

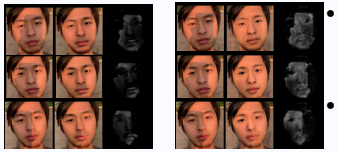
- GS+C improves over naive RGB shadow modeling and the baselines.

Shadow Segmentation and Removal on SFW

Segmentation Model	AUC	Accuracy
Le and Samaras [25]	0.603	0.683
Hu *et al.*[21]	0.540	0.604
He *et al.*[18]	0.725	0.858
GS+C (Ours)	0.824	0.888
Temporal GS+C (Ours)	**0.836**	**0.890**

- Temporal GS+C achieves SoTA segmentation and removal results.
- Temporal GS+C improves over GS+C by enforcing face symmetry for single images.

Video Shadow Removal on SFW



Video Shadow Removal (no TSM) | Video Shadow Removal (w/ TSM)

- TSM improves temporal consistency of video shadow removal.
- TSM leaves less shadow traces and estimates better shadow masks.

Takeaways

- Decomposing shadow removal into grayscale shadow removal and colorization improves over naive RGB shadow modeling.
- Temporal max pooling can share illumination information across frames and improve temporal consistency of shadow removal.