ARGAN: Attentive Recurrent Generative Adversarial Network for Shadow Detection and Removal

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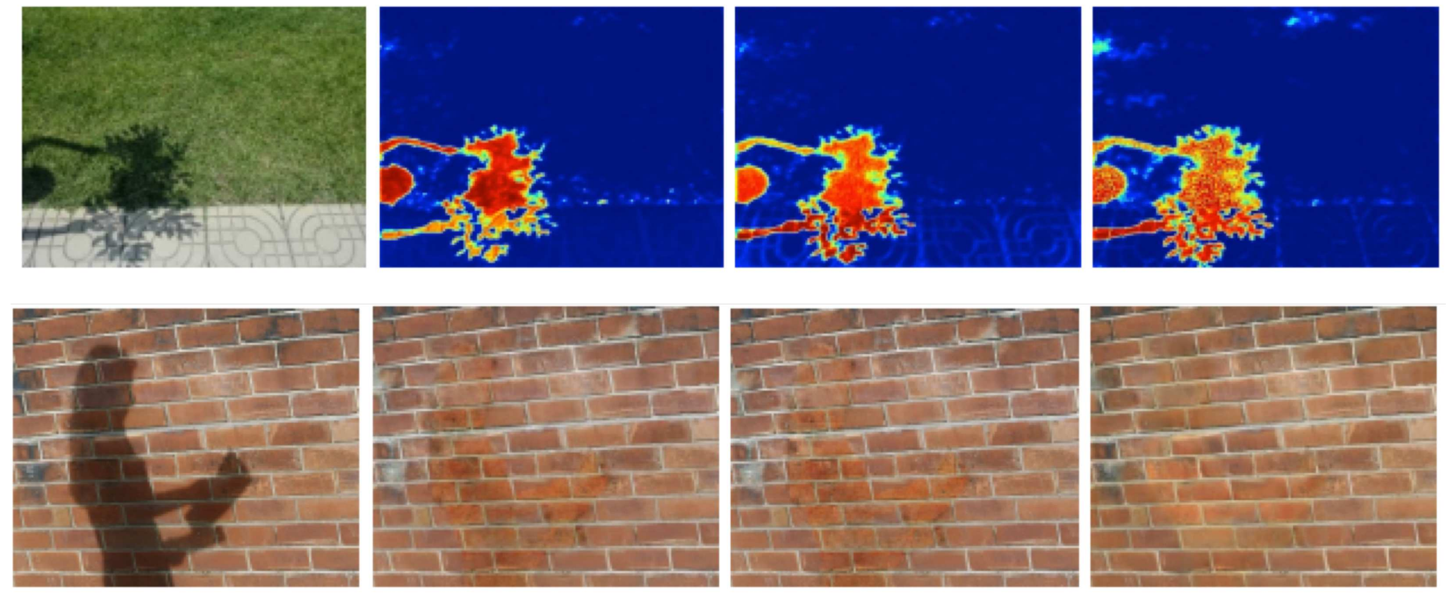
Problem & Background

- Traditional methods often base on some prior knowledge, such as consistent illumination in the shadow regions. But the priors might dissatisfy some shadow images under a complex environment.
- Learning-based methods rely heavily on supervised data to learn a robust model. When the training data is insufficient, such methods often appear color distortion or other problems in the shadow removal results.

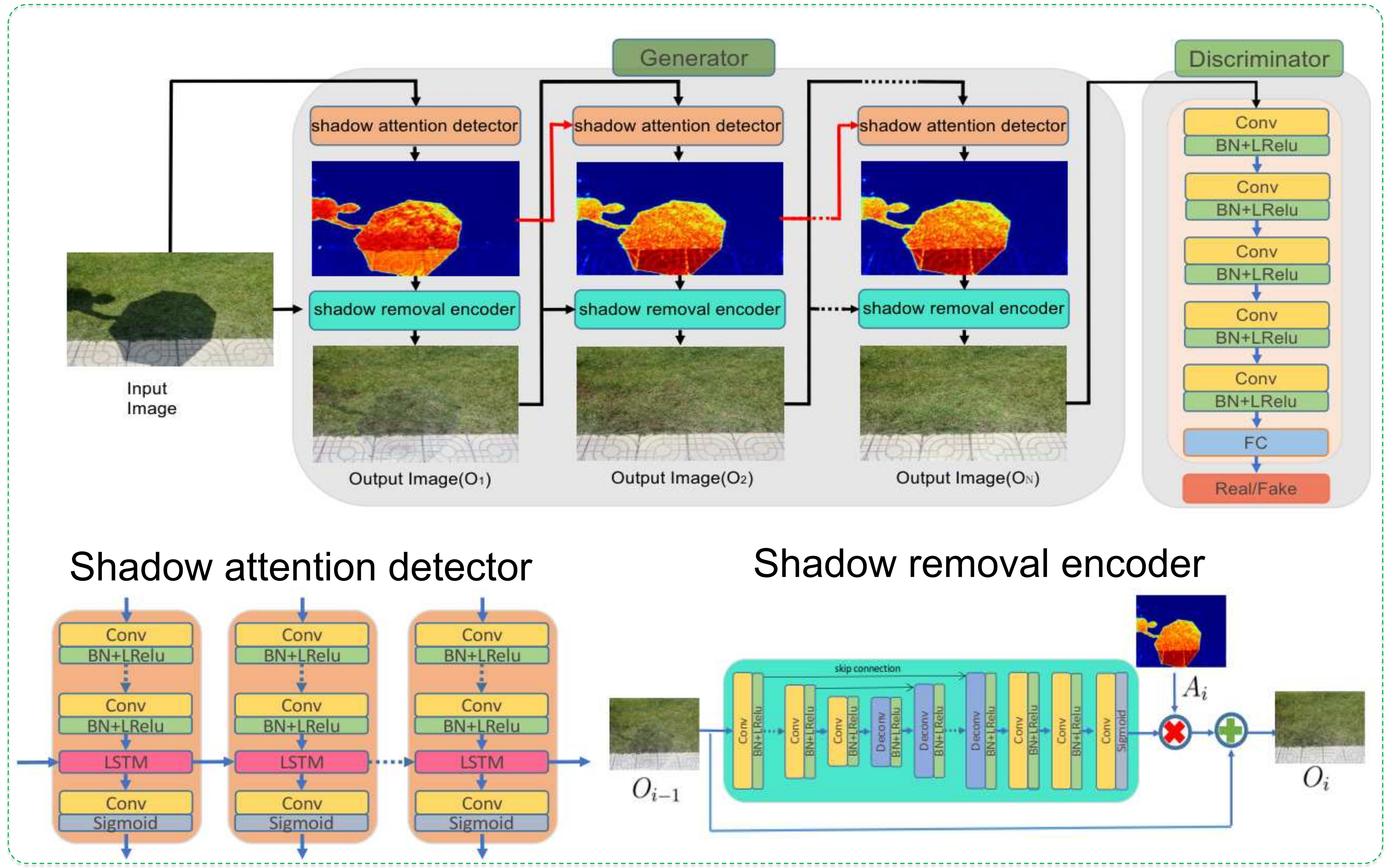


Contributions

- Our proposed ARGAN adopts adversarial training process to optimize each shadow attention detector and each shadow removal encoder in the generator.
- The generator involves multiple progressive steps for shadow detection and removal in a coarse-to-fine fashion so that it can handle shadows with complicated environment.
- A semi-supervised strategy by incorporating sufficient unsupervised shadow images available online is able to increase the robustness of our network.

$$L_{adv} = \lambda \mathbb{E}_{(I,F)}[log(D(y)) + log(1 - D(G(I)))] + (1-\lambda)\mathbb{E}_{(\hat{I})}(log(1 - D(G(\hat{I})))),$$

Proposed Approach



Datasets and Metrics

Detection (BER) : SBU, UCF, ISTD; Removal (RMSE) : SRD, ISTD.

Quantitative Results

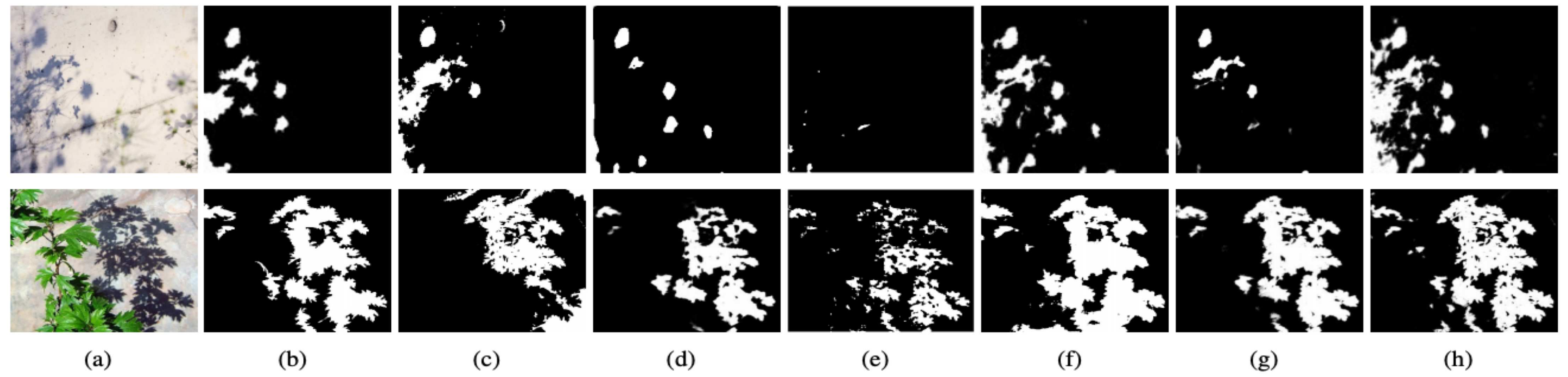
	Year	SBU	UCF	ISTD
Guo	2011	25.03	28.32	27.16
Zhang	2015	7.13	9.21	8.56
DSC	2018	5.31	8.73	2.40
ST-CGAN	2018	13.56	17.69	3.84
A+D Net	2018	7.67	11.05	2.97
BDRAR	2018	6.61	9.45	2.20
AGAN	2019	7.24	8.67	4.23
ARGAN	2019	3.09	3.76	2.01
ARGAN+SS	2019	2.56	3.03	1.75

Shadow detection

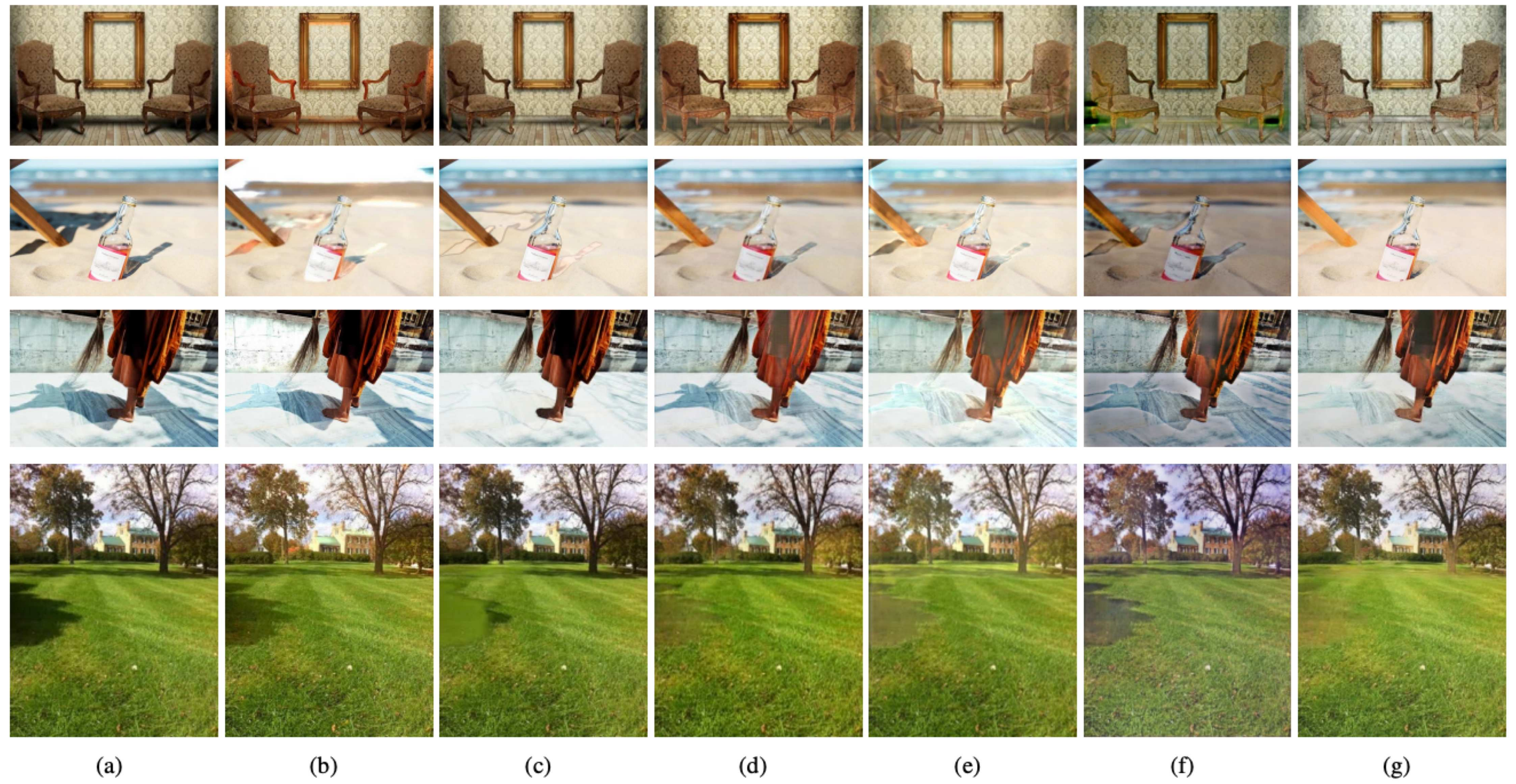
	SRD			ISTD		
	S	N	A	S	N	A
Guo	29.89	6.47	12.60	18.95	7.46	9.3
Zhang	9.56	6.9	7.24	9.77	7.12	8.16
DeshadowNet	17.96	6.53	8.47	12.76	7.19	7.83
ST-CGAN	18.64	6.37	8.23	10.31	6.92	7.46
DSC	11.31	6.72	7.83	9.22	6.50	7.10
AGAN	14.68	5.94	7.65	11.79	6.33	7.57
ARGAN	7.24	4.71	5.74	7.21	5.83	6.68
ARGAN+SS	6.35	4.46	5.31	6.65	5.41	5.89

Shadow removal

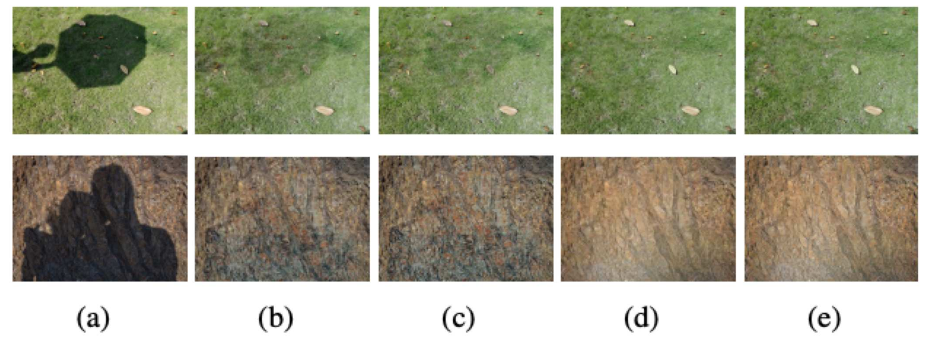
Qualitative Results



Shadow detection results comparisons. From left to right are input images (a), results of Guo (b) Zhang (c), DSC (d), ST-CGAN (e), A+D Net (f), BDRAR (g), and our ARGAN (h), respectively.



Shadow removal results. From left to right are input images (a), results of Guo (b), Zhang (c), DeshadowNet (d), DSC (e), ST-CGAN (f), and our ARGAN (g), respectively.



The shadow removal results of recurrent N in a different value. (N=1, 2, 3, 4.)

The visualization results of ablation analysis. From left to right are the input image, shadow removal results without using LSTM, without using unsupervised data, and our results.

Acknowledgement

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Key References

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