Removing Shadows from Images of Documents

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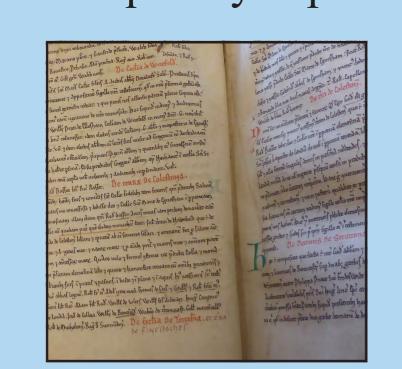
UCSB

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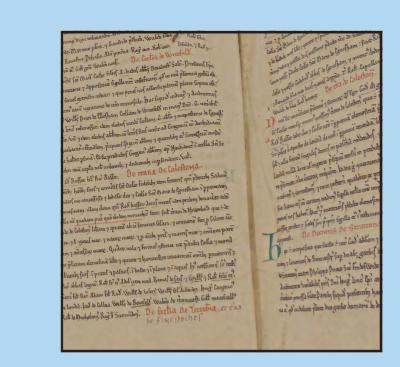
Adobe

Motivation

• Images of documents, receipts, menus, books, newspapers, flyers, signs, and other text are frequently captured with distracting shadows.



Problem: Distracting shadows



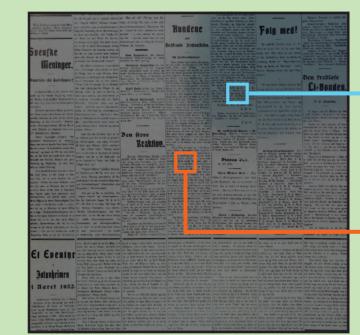
Goal: Remove shadows, keep original color and tone

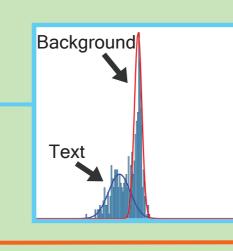
Previous Work

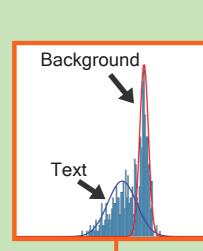
- Observation: Most documents have a constant colored background
- State-of-the-art method from Oliveira et al. [2013] generates gain map in background-only (i.e., no text) regions, but has interpolation inaccuracies.
- We also compare with Gong et al. [2014], which performs general shadow removal of natural images based on heuristics using user-defined brush strokes in bright and shadow regions.

Our Approach

- Our technique estimates text and background colors in local blocks to generate a shadow map, or per-pixel gain, to match local estimates to a global reference.
- Steps of our algorithm:
 - (1) Cluster intensities in small blocks as text and background. Select text cluster mean as local reference.



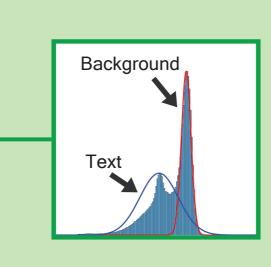




Input

(2) Repeat Step 1 using the entire image to get global reference background intensity.





Input

(3) Generate shadow map, α_i , by dividing local background, ℓ_i , by global reference, g.



$$oldsymbol{lpha}_i = rac{oldsymbol{\ell}_i}{oldsymbol{\sigma}}$$

Shadow Map

(4) Apply shadow map to original input, \mathbf{c}_i , to get deshadowed output, $\tilde{\mathbf{c}}_i$.



$$ilde{\mathbf{c}}_i = rac{\mathbf{c}_i}{oldsymbol{lpha}_i}$$

Output

Results - Controlled









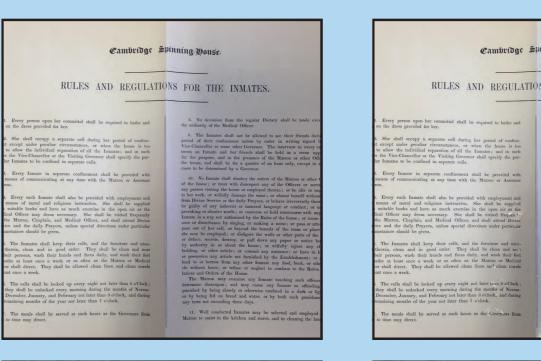
Gong et al. [2014]

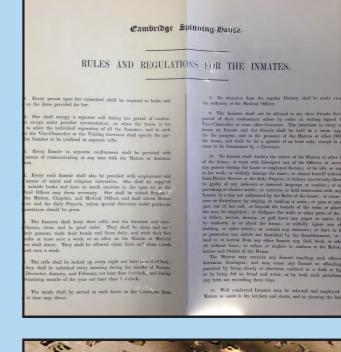
Oliveira et al.

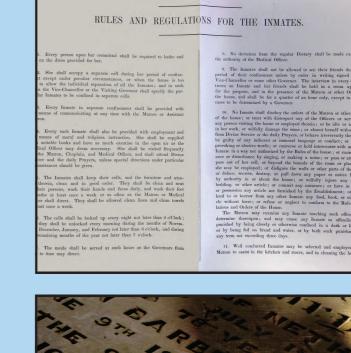
• We provide a comparison with previous approaches evaluating average and median MSE on our controlled dataset consisting of 81 images.

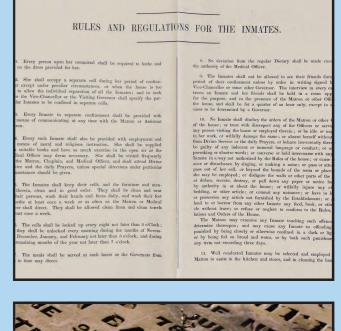
Method	Avg. MSE	Median MSE
Bell et al. [2014]	125.44	119.94
Gong et al. [2014]	390.98	172.57
Pilu et al. [2002]	67.38	53.54
Wagdy et al. [2013]	74.06	43.73
Oliveira et al. [2013]	23.08	19.01
Ours	22.26	18.45

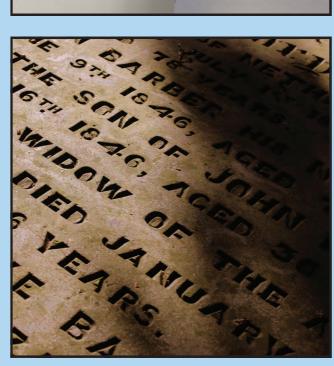
Results - Flickr

















ons as anxiety are linked to ou it is going on around us. If there i g around and beneath us we may no ely. This is anxiety. Could it be ileptic seizure? But no, it is an ear s on a different perspective. W we have made sense of it. areness that we have problems such as hostility or guilt, are disc ese transitions play a

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Input

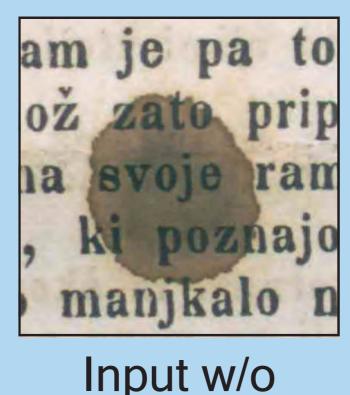
Gong et al. [2014]

Oliveira et al. [2013]

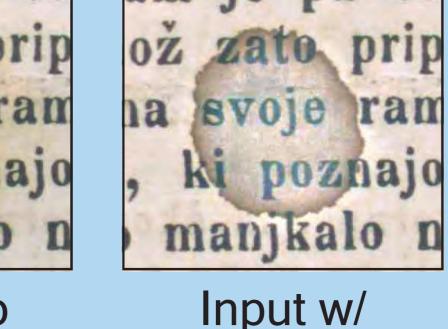
Ours

Image Binarization

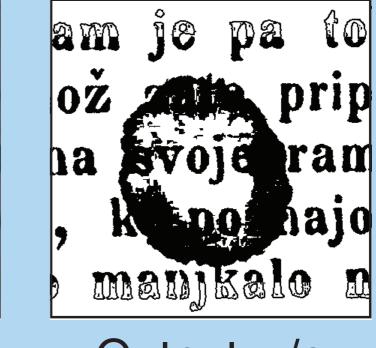
• Use our method as a pre-process for inputs to image binarization used in Optical Character Recognition (OCR) tasks

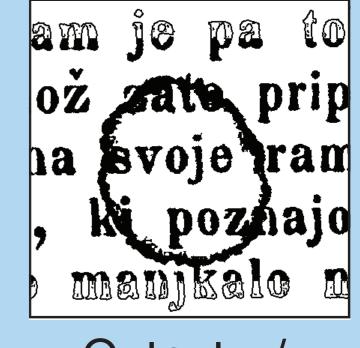


Ours



Ours

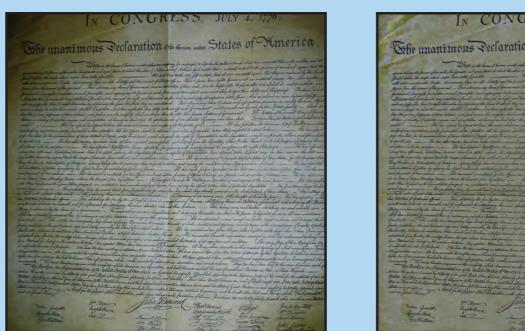




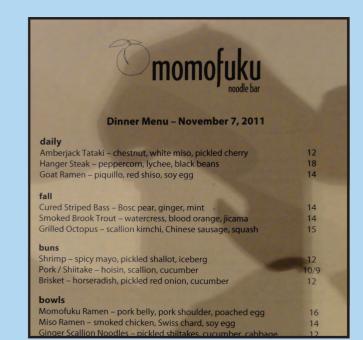
Output w/o Ours

Output w/ Ours

Limitations



Varying backgrounds Incorrect global statistics



Harsh shadows Incorrect local statistics