Learning a Discriminative Model for the Perception of Realism in Composite Images

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code and data: www.eecs.berkeley.edu/~junyanz/projects/realm/

What is a Composite Image?

Foreground + Background = Image Composite

Which Photo Looks Realistic?

Natural Realistic Composite
Unrealistic Composite

Photo Forensics
Visual Realism

Our Goals: (1) Learn a visual realism model without using human annotations. (2) Improve image compositing by optimizing visual realism.

Overview

Realism CNN

Realism Modeling

Natural photos

More realistic

Realism score: 0.0

Original Composite

Predict Realism

Improve Composites

Image Editing Model

Automatically Generating Composites

Target object

Object mask

Composites

Object masks with similar shape

Ranking of Negative Training Examples

Most realistic composites

Least realistic composites

Image Composites

Improving Object Compositing

E(g, F) = E_{CNN} + E_{reg}

Realism Prediction Results

Evaluation

Dataset (Lalonde and Efros [1])
- 360 realistic photos (natural images, realistic composites)
- 360 unrealistic photos (no mask)

Area under ROC Curve

Table:

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<thead>
<tr>
<th>Method</th>
<th>Visual Realism Ranking</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Least Realistic</td>
</tr>
<tr>
<td><strong>Snaky Mountain</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Highway</strong></td>
<td></td>
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<tr>
<td><strong>Ocean</strong></td>
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</table>
| Red: unrealistic composite, Green: realistic composite, Blue: natural image

Methods without object mask

- Color Palette [2] (no mask): 0.61
- VGG Net + SVM: 0.76
- RealismCNN: 0.84
- RealismCNN + SVM: 0.88
- Human: 0.91

Methods using object mask

- Reinhard et al. [2]: 0.66
- Lalonde and Efros [1] (with mask): 0.81

- Indoor Dataset: 0.83 (RealismCNN)
- Object Proposals vs. Annotated Segments: 0.84 vs. 0.88 (with SVM)

Reference


Optimizing Color Compatibility

Evaluation (average Human ratings)

<table>
<thead>
<tr>
<th>Method</th>
<th>Unrealistic Composites</th>
<th>Realistic Composites</th>
<th>Natural Photos</th>
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</thead>
<tbody>
<tr>
<td>Cut-n-paste</td>
<td>0.034</td>
<td>0.338</td>
<td>0.347</td>
</tr>
<tr>
<td>[1]</td>
<td>0.123</td>
<td>-0.299</td>
<td>-0.247</td>
</tr>
<tr>
<td>[3]</td>
<td>-0.410</td>
<td>-0.242</td>
<td>-0.237</td>
</tr>
<tr>
<td>Ours</td>
<td>0.311</td>
<td>0.279</td>
<td>0.196</td>
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- Significantly improve the visual realism of unrealistic composites.
- Does not alter much color distribution of realistic composites and natural photos.

Selecting Suitable Objects

Best-fitting object selected by RealismCNN

Object with the most similar shape

- Natural
- Unrealistic
- Mountain
- Snowy
- Highway
- Ocean

- Realistic
- Natural photos

- Unrealistic composite

- Most similar shape

- Image 44x2325 to 260x2541

- Image 410x1389 to 662x1641

- Image 410x1874 to 662x2126

- Image 822x429 to 984x573

- Image 822x279 to 984x423

- Image 989x279 to 1151x423

- Image 1268x429 to 1430x573

- Image 1268x579 to 1430x723

- Image 1268x279 to 1430x423

- Image 1276x112 to 1278x139

- Image 1285x112 to 1287x139

- Image 1424x112 to 1426x139

- Image 1428x112 to 1430x139

- Image 1670x1721 to 1968x1993

- Image 1682x1040 to 1691x1691

- Image 1696x2009 to 1741x2117

- Image 1863x570 to 1868x731

- Image 1877x2394 to 1920x2394

- Image 1965x267 to 2134x267

- Image 2204x906 to 2245x171

- Image 2249x587 to 2419x731

- Image 2264x1810 to 2451x1932

- Image 2284x1173 to 2337x1038

- Image 2378x1939 to 2596x1939

- Image 2426x587 to 2596x731

- Image 2446x1578 to 2612x1708

- Image 2499x1810 to 2686x1932

- Image 2529x906 to 2790x906

- Image 2799x628 to 3002x668

- Image 2817x37 to 3004x173

- Image 3100x1810 to 3287x1932