Taking Great Pictures
(Automatically)

Computational Photography
(15-463/862)

Yan Ke
11/27/2007
Anyone can take great pictures...
... if you can recognize the good ones.
F8 and Be There

- Anyone can win a Pulitzer…

- In twenty years, many photo journalists will be out of jobs (CNN I-Report, Wikinews....)

Election Campaign, Clinton, Associated Press
Outline

- Photography 101
- Recognition
  - What makes one photo better than another?
  - What features can we extract?
  - How can we measure our performance?
- Enhancement
  - How do we improve photos?
  - How can we do it automatically?
Photography 101

- Composition
  - Rule of thirds
  - Framing
  - Leading lines
  - Textures and patterns
  - Color coordination

- Lighting
  - Direction
  - Color balance
Rule of Thirds
Leading Lines
Framing
Textures and Patterns
Color Coordination
Lighting
Front Lighting
Side Lighting
Back Lighting
Outline

- Photography 101
- Recognition (CVPR ’06)
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Not Critiquing Art

Piet Modrian

Lothar Wolleh
What makes one photo better than another?

- Simplicity
- Realism
- Basic photographic techniques
Simplicity

“Look Into” by Josh Brown @ Flickr
Simplicity

“alien flower” by Josef F. Stuefer @ Flickr
Simplicity

“Waiting in line!” by Imapix @ Flickr
Realism

“Golden Gate Bridge at Sunset” by Buzz Andersen @ Flickr

“Golden Gate 3” by Justin Burns @ Flickr
Realism

“Somewhere Only We Know Prt2 (sic)” by Aki Jinn @ Flickr
Realism
Basic techniques

- Blur
- Contrast and brightness
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Features – Spatial Distribution of Edges

“Picture of a picture…” by Ted Johnson @ Flickr
Spatial Distribution of Edges

Low quality photos

High quality photos

$M_s$

$M_p$
Spatial Distribution of Edges
Color Distribution

- K-NN on color histogram

\[ q_{cd} = \# professional\_neighbors \]
$$q_h = 20 - (#\text{ hues} \succ threshold)$$
Look at frequency distribution.

Measure the amount of blur in the sharpest object, instead of the average blur.
Low Level Features - Contrast
Low Level Features – Avg. Brightness
Classifier

- Naives Bayes
- We assume independence of the features
- We achieve better results with added features even though they are not independent.
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## Dataset – DPChallenge.com

- **60K photos**
- **40K photographers**
- **10/90 percentile**

### Statistics

<table>
<thead>
<tr>
<th>Place</th>
<th>Avg (all users)</th>
<th>Avg (commenters)</th>
<th>Avg (camera)</th>
<th>Avg (no camera)</th>
<th>Views since voting</th>
<th>Views during voting</th>
<th>Votes</th>
<th>Comments</th>
<th>Favorites</th>
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### Voting Breakdown

<table>
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<tr>
<th>Rating</th>
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<td>1</td>
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</tr>
<tr>
<td>9</td>
<td>89</td>
</tr>
<tr>
<td>10</td>
<td>105</td>
</tr>
</tbody>
</table>

- Add this photograph to your favorites!

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60K photos
40K photographers
10/90 percentile
Difficulty of Dataset

![Graph showing the difficulty of dataset with two curves: Snapshot (blue circles) and Professional (green pluses). The x-axis represents rating from 1 to 10, and the y-axis represents the difficulty level ranging from 0 to 0.14. The graph illustrates the distribution of difficulty across different rating levels.]
Results

recall = \frac{\text{# professional photos above threshold}}{\text{total # professional photos}}

precision = \frac{\text{# professional photos above threshold}}{\text{# photos above threshold}}
Most Distinctive Feature: Blur

- A *badness* metric, rather than a *goodness* metric.
Results

Recall
Precision
Combined

Recall
Precision
0.5
0.6
0.7
0.8
0.9
1

Edge Spatial Distribution
Edge Bounding Box Area
Hue Count

Recall
Precision
Blur
Color Distribution
Contrast
Brightness
Web Retrieval Results
Web Retrieval Results
Beyond this paper

- Rule of Thirds
- Patterns and textures
Rule of Thirds

- Object detection
- Saliency
  - “Learning to Detect A Salient Object”, Liu, Sun, Zheng, Tang, Shum, CVPR ’07.
- Where is the horizon?
Eye Controlled Focus
“Extracting Texels in 2.1D Natural Textures”, Ahuja, Todorovic, ICCV ’07.
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Beyond the (Digital) Dark Room
Low-level Enhancements

“I’m Feeling Lucky”
Exposure

- **Scene detection**
  - Canon’s “Evaluative”
  - Nikon’s “3D Matrix Metering”

- **People/Face/Skin detection**
  - Canon’s Face Detection

- “Context-based vision system for place and object recognition”, Torralba, Murphy, Freeman, Rubin, ICCV ’03.
- “Robust Real-time Object Detection”, Viola, Jones, IJCV ’05.
Color Balance

- **Object recognition**
  - Face / Skin
  - Sky
  - Water
  - Trees

- “The von Kries Hypothesis and a Basis for Color Constancy”, Chong, Gortler, Zickler, ICCV ’07.
High-level Enhancements

- Case Study – Portraits
Eyes are windows into the soul

- Red eye reduction
- Catch lights
- Eye whites
- Pupil size

- “Corneal Imaging System: Environment from Eyes”, Nishino and Nayar, IJCV ’06.
- “Red eye detection with machine learning”, Ioffe, ICIP ’03.
Making People Slimmer
(the wrong way)

HP Digital Photography

Slimming photos with HP digital cameras

With the slimming feature, anyone can appear more slender—instantly!

Without slimming effect

With slimming effect
“From Few to Many: Illumination Cone Models for Face Recognition Under Variable Lighting and Pose”, Georghiades, Belhumeur, Kriegman, PAMI ’01.

“Multilinear Subspace Analysis of Image Ensembles”, Vasilescu, Terzopoulos, CVPR ’03.
Detect and Adjust Pose

- “PoseCut: Simultaneous Segmentation and 3D Pose Estimation of Humans using Dynamic Graph-Cuts”, Bray, Kohli, Torr, ECCV ’06.
- "Strike a Pose: Tracking People by Finding Stylized Poses”, Ramanan, Forsyth, Zisserman, CVPR ’05.
- Poser by e frontier
3D Face Alignment – Apply and Transfer

- “3D Alignment of Face in a Single Image”, Gu and Kanade, CVPR ’06.
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Questions?