What Makes a Great Picture?

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With many slides from Yan Ke, as annotated by Tamara Berg

15-463: Computational Photography
Alexei Efros, CMU, Fall 2008
Photography 101

• Composition
  • Framing
  • Rule of Thirds
  • Leading Lines
  • Textures and Patterns

• Lighting
  • Direction
  • Color coordination / balance
  • “Golden Hour”
Framing

“Photography is all about framing. We see a subject -- and we put a frame around it. Essentially, that is photography when all is said and done.”

-- from photo.blorge.com
Frame serves several purposes:

1. It gives the image depth
2. Use correctly, framing can draw the eye of the viewer of an interest to a particular part of the scene.
3. Framing can bring a sense of organization or containment to an image.
4. Framing can add context to a shot.

http://digital-photography-school.com/blog/frame-your-images/
Examples of nice framing

http://flickr.com/photos/paulosacramento/226545698/
http://flickr.com/photos/chrisbeach/13868545/
http://flickr.com/photos/74531485@N00/929270814/
http://flickr.com/photos/freakdog/223117229/
http://flickr.com/photos/cdm/253805482/
Rules of Thirds

http://www.photo96.com/blog/?p=371
Other examples
Leading Lines
More examples
Textures and Patterns
Complementary colors (of opposite hue on color wheel)
Front Lighting
Side Lighting
Back Lighting
Photography 101

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Anyone can take great pictures...
I am a sucky photographer...
…but I am a pretty good photo critic!

http://flickr.com/photos/aaefros/

# of my Paris photos on Flickr: 32
Total # of my Paris photos: ~1250

~2%
The Postmodern Photographer

The Old Days: a pre-process
- Load film
- Find subject
- Position camera
- Set all the settings “just right”
- Take a deep breath…
- ...Press button!

The New Digital Days: a post-process
- Get a 2 GB memory cartridge
- Take pictures like there is no tomorrow!!!
- ...
- Back home, spend hours of agony trying to find 1-2 good ones
How to recognize the good photos?
Outline

- Photography 101
- Recognition (CVPR ’06)
  - What makes one photo better than another?
  - What features can we extract?
  - How can we measure our performance?

Not considering semantic measures of what makes a photo good (subject matter, humor, etc). Professional = those you would frame, snapshot = those that would stay in photo album.
Applications

Image search for improved quality along with relevance. Automatically select the best photos from a set of vacation pictures to choose the best ones to show. See if computer can perform well on a traditionally human task.
What makes one photo better than another?

- Simplicity
- Realism
- Basic photographic techniques
Prof - Obvious what one should be looking at ie easy to separate subject from the background. Snap – unstructured, busy, filled with clutter.
Simplicity

“Waiting in line!” by Imapix @ Flickr
Basic techniques

- **Blur** - Snaps – entire photo blurry indicates poor technique. Prof - background out of focus by widening the lens aperture, but foreground in sharp focus.

- **Contrast and brightness** Make the subject pop out by choosing complementary colors for subject & background. Isolate the subject by increasing lighting contrast between subject & background.

Abstract concepts - “Good composition, color & lighting”
(Sur) Realism

Snaps look real, while prof photos look surreal.

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

“Golden Gate 3” by Justin Burns @ Flickr
(Sur) Realism

“Somewhere Only We Know Prt2 (sic)” by Aki Jinn @ Flickr
Techniques

Lighting conditions – time of day (morning, dusk), colored filters to adjust color balance (make sky bluer, sunset more brilliant), careful color selection of scene

Camera settings – adjust settings like focal length, aperture, shutter speeds to modify mood, perspective. Eg might use long shutter speed to capture waterfall and give a misty look

Subject matter – ordinary objects in unusual poses or settings (challenging since would need obj rec first)
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Features – Spatial Distribution of Edges

More edges near border due to background clutter

More edges near center of img

Trying to capture a photo’s “simplicity”

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

Mean Laplacian of snapshots

Mean Laplacian of professional

More uniformly distributed

More concentrated

Low quality photos

High quality photos

Expect high quality photos to have high spatial frequency edges nearer to center than snapshots
Edge width

Calculate area that edges occupy – width of bounding box covering 96% of edge energy.

Cluttered regions should tend to produce a larger bounding box, and well defined subjects should produce a smaller one.
Color Distribution

- **K-NN on color histogram**

For query image find $k$ nearest neighbors in training set.

Quality = number of prof neighbors in top 5.

$q_{cd} = \# \text{professional neighbors}$
# unique hues smaller for prof photos even though they tend to look more vibrant and colorful (S,V may vary more) – another measure related to “simplicity”

\[ q_h = 20 - (\# \text{ hues} > \text{threshold}) \]
Most unlikely colors…

From Lalonde and Efros, ICCV’2007
Blur

- Look at frequency distribution.
- Measure the amount of blur in the sharpest object, instead of the average blur.
Prof photos usually have higher contrast

Contrast = width of middle 98% mass of hist
Professional photographers may adjust exposure to be correct on subject only so subj pops from bkd. Cameras tend to adjust brightness to average at 50% gray, but prof photos might deviate significantly. Use ave brightness as feature.
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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Use photos average rating as ground truth quality measure

Use only top 10%, bottom 10% as dataset.

Use half for training/half for testing.
Difficulty of Dataset

![Graph showing difficulty distribution of Snapshot and Professional data.]
Results

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

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

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

72% classification rate
Web Retrieval Results
Web Retrieval Results
Web Retrieval Results
Looking back…

1. Why we were here?
2. What did we learn?
3. How is this useful?
Our Goal: The Plenoptic Function

Figure by Leonard McMillan
Our Tools: The “Theatre Workshop” Metaphor

(Adelson & Pentland, 1996)
Painter (images)
Lighting Designer (environment maps)
Sheet-metal Worker (geometry)
… working together
How is this useful?

1. You learned a basic set of image-based techniques
   - All quite simple
   - Most can be done “at home”
2. You have your digital camera
3. You have your imagination

Go off and explore!
THANK YOU!

That's All Folks