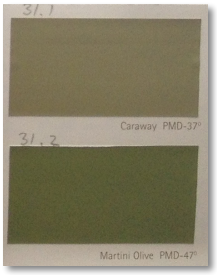
Project 1: the color problem

In this project you will first use your camera to capture images of the Macbeth ColorChecker chart and paint samples that you will be using throughout the semester to develop a color-calibrated imaging workflow. You will then create a Matlab script do some pre-processing on these images to put them into a more convenient form, and to gain experience with Matlab's image processing tools. You will then set up your laptop display so that it's in a standard calibration state. Finally you will evaluate how well the colors in your images match the colors of the real objects.

We will be using the Macbeth ColorChecker (CC) chart throughout the semester as a color standard for measurement, analysis, and rendering. You will also be given a pair of latex paint samples for additional testing that have been numbered in pairs (e.g."31.1", "31.2"). Whenever you refer to the samples in your work please use the reference numbers.



To provide a consistent viewing environment and known source of illumination for color evaluation, we will be using a color-viewing booth that contains a standard (D50) light source. The booth will normally live in a lab to which you will have card access. It is important to let the booth "warm-up" for ~10 minutes so the lights stabilize before taking any pictures or doing visual evaluations. It is also really important to turn the light booth off when you're done using it so the expensive bulbs don't wear out.

1) a) Place the ColorChecker chart and your paint samples in the lightbooth and take a high-resolution, well-exposed, well-focused, no-flash, full-frame, level color picture of the chart and your patches using your camera. Include some of the background as shown to aid camera white-balancing. b) Save the image as a max-quality JPEG with the filename "yourlastname_yourcamera.jpg".

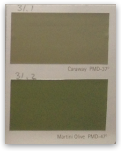
- ferwerda_iphone5s.jpg

2) Using the functions in the MATLAB image processing toolbox, write a script to do the following:

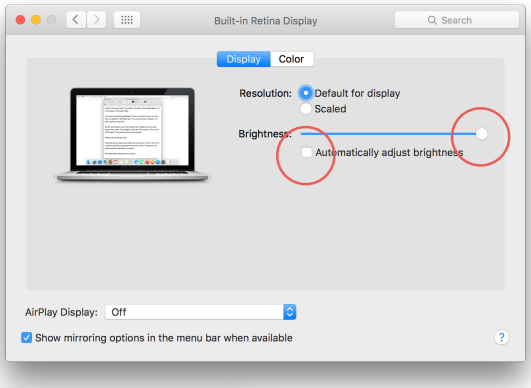
a) read in the image you created in step 2)
b) if necessary, rotate the image so the chart is level
c) crop the chart and samples out of the main image
d) resize the chart crop to be 1125x800 pixels
e) resize the samples crop to be 225x300 pixels
f) save the chart crop as “chart.jpg”
g) save the samples crop as “samples.jpg”

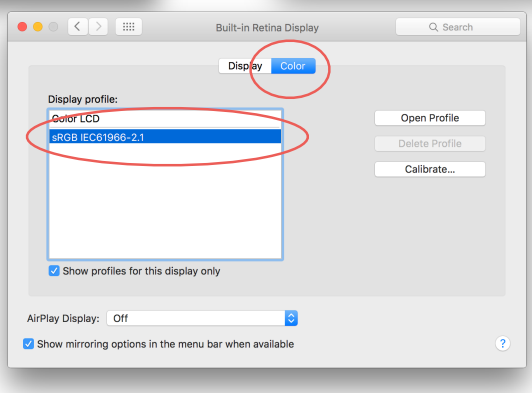
chart.jpg (1125x800)

samples.jpg (225x300)



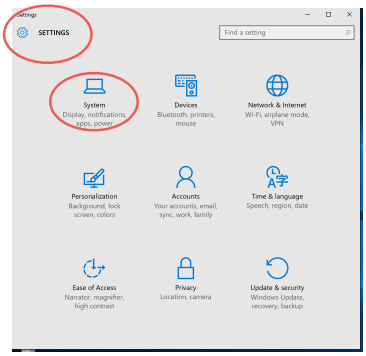
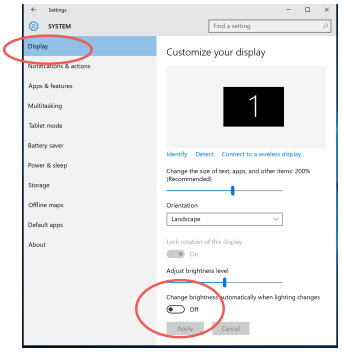
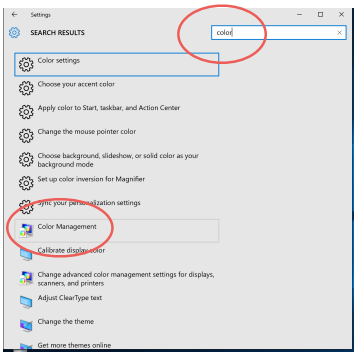
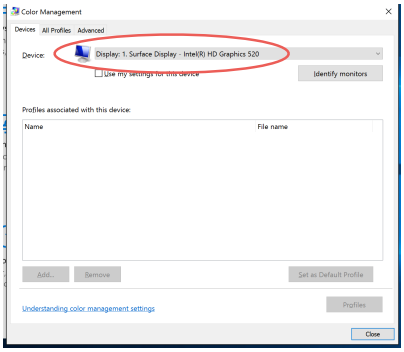
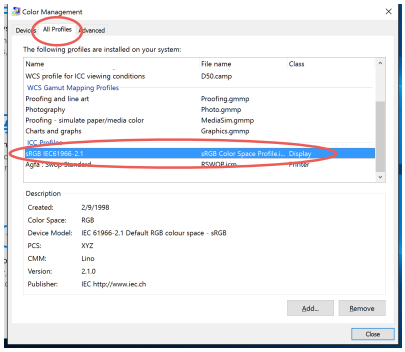
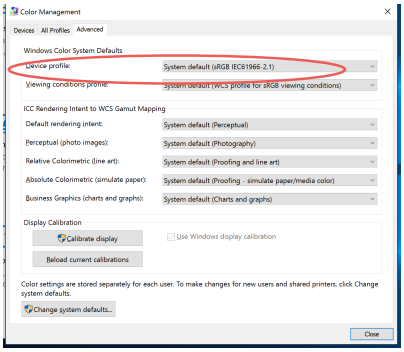
3 (for OSX)) Follow the dialogs below to set your display so it does not do auto-brightness adjustment and uses a standard sRGB display profile.





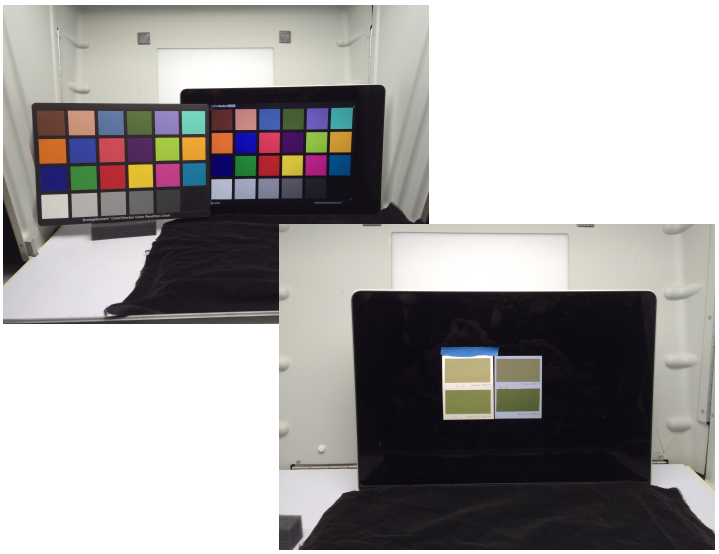
- use the sRGB IEC61966-2.1 display profile

3 (for Windows)) Follow the dialogs below to set your display so it does not do auto-brightness adjustment and uses a standard sRGB display profile.

- use the sRGB IEC61966-2.1 display profile

4) a) Use Photoshop or GIMP to show your “chart” image on your laptop. Adjust the scaling so the image appears to be the same size as the real chart. Maximize the display brightness. b) Put your laptop in the lightbooth next to the real chart. Place the black cloth over the keyboard and adjust the screen so you can see it without reflections. c) Compare each imaged color patch with each real color patch and fill in the “color_eval_table.xlsx” spreadsheet to record how the imaged patch differs from each real patch. Use terms of lightness (lighter/darker), hue (redder/greener/yellower/bluer or combinations more/less purple, orange, etc.) and saturation (more/less). d) Take a high quality photo of your setup like the one shown below. e) Repeat steps a-d) with your “samples” image.



real/imaged patches
initial color comparison
names:
team #:

patch #	patch name	imaged patch appearance
1	dark skin	darker
2	light skin	darker, redder
3	blue sky	darker, more saturated
4	foliage	...
5	blue flower	
6	bluish green	
7	orange	
8	purplish blue	
9	moderate red	
10	purple	
11	yellow green	
12	orange yellow	
13	blue	
14	green	
15	red	
16	yellow	
17	magenta	
18	cyan	
19	white (.05)	
20	neutral 8	
21	neutral 6.5	
22	neutral 5	
23	neutral 3.5	
24	black	
	patch X.1	
	patch X.2	

IMGS-351
Project 1 post-mortem

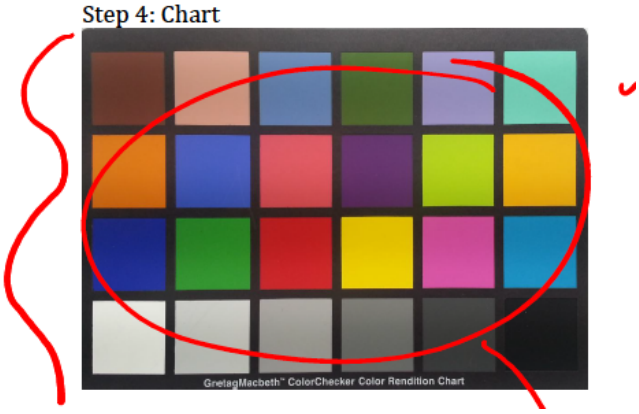
a.k.a Problems to avoid

Non-uniform illumination/exposure

Step 6 Lightbooth: Chart

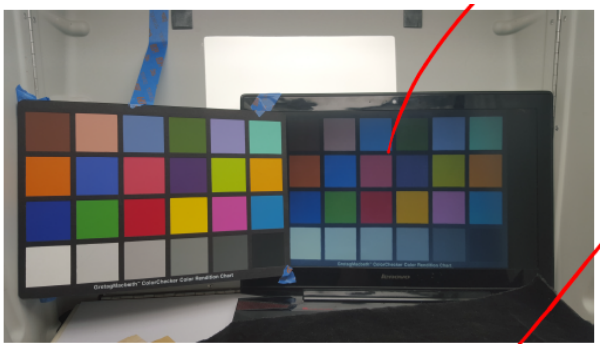
- only overhead booth light should be on
- “transparency” backlight should be off

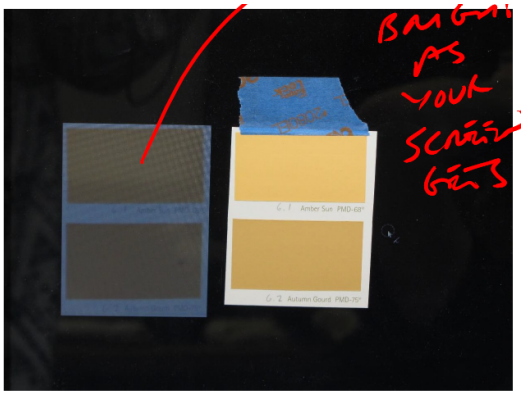
Step 4: Chart



- shutters in some phones “beat” with the 60Hz light frequency produces images with dark stripes
- adjust view distance or (shutter parameters if possible) until image appears uniform

Object/screen brightness mismatch

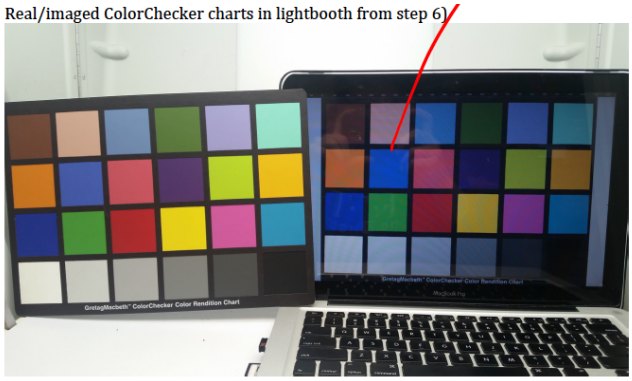




- screen should be adjusted to have ~same brightness as test objects

Reflections

Real/imaged ColorChecker charts in lightbooth from step 6)

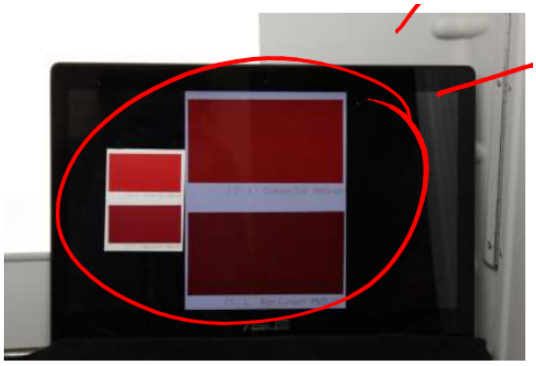


- turn off room lights
- cover keyboard with black cloth
- stay back far enough that you are not illuminated

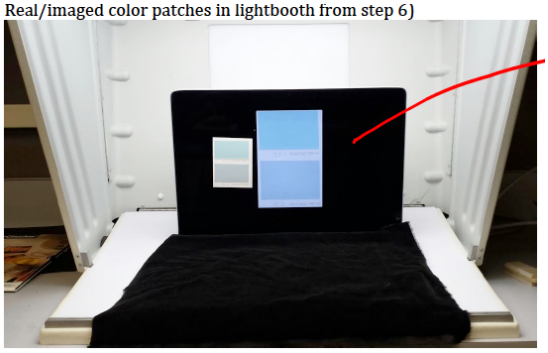
Compression artifacts

- original images should use lossless or “high quality” lossy compression

Size mismatch



Real/imaged color patches in lightbooth from step 6)



- perceived color varies with target size
- same sizes will provide the most reliable assessment of color match/mismatch

5) Project report. a) Download and unzip the “project1_resources.zip” on myCourses file to your working directory. b) Use the “teamX_project1.doc” file as a template for submitting your report. Fill in the sections with your images and results and answer any questions. c) **Save your completed report as a single PDF file**. d) **Name your report team#_report1.pdf.** e) **Submit a single copy of your report** to the project 1 dropbox in myCourses.

Notes:

- A single PDF. I really mean it.
- Named as indicated. I mean this as well.
- One report per team (Please designate one team member as the submitter. I will credit both team members when grading).
- Take the time to make your report “professional” (i.e. complete, well-formatted, legible graphics, correct spelling, etc…). I will be taking these factors into consideration when grading.