

**Name (netid):** Rahul Grover (rgrover4)

**CS 445 - Project 1: Hybrid Images**

Complete the claimed points and sections below.

**Total Points Claimed** **[100] / 130**

1. Hybrid image main result
  - a. Main result and description [45] / 45
  - b. FFT images of main result [15] / 15
2. Hybrid images: two additional results [10] / 10
3. Image enhancement tasks (3rd is B&W)
  - a. Contrast enhancement [0] / 10
  - b. Color enhancement [10] / 10
  - c. Color shift [10] / 10
4. Quality of results / report [10] / 10
5. Color Hybrid Image w/ explanation (B&W) [0] / 5
6. Gaussian / Laplacian Pyramids (B&W) [0] / 15

## 1. Hybrid image main result

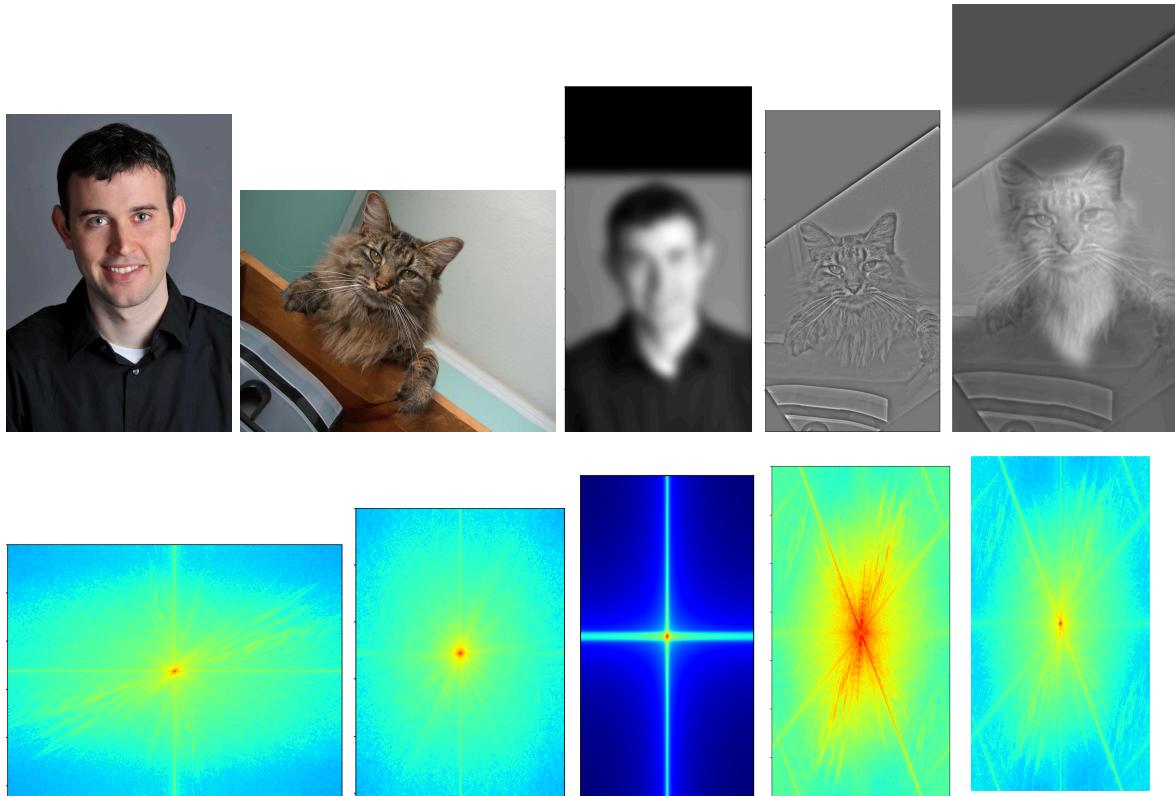
Include

- Original and filtered input images
- Hybrid image result
- FFT images of each original and filtered image and the hybrid image
- Description in a few sentences of how it works using the included images as illustrations. Explain parameter settings and any clever ideas that are incorporated.
- All results must be based on your own images (can be from web with attribution, but not provided samples)

Original and filtered input images (low-pass on Derek and high-pass on the Cat)

Hybrid image as a result of the two filtered images on the end →

`Sigma_low = 20, Sigma_high = 12`



Corresponding FFT images below matching images

Essentially, the two images are passed under a low-pass filter, and a high-pass filter which filters based on the input values of `sigma_low` and `sigma_high`. These two input values determine how our filter is applied to the images. As the value of `sigma_low` increases, our low-pass filter smooths out larger areas of the image, making it appear more blurred as seen by the above image with Derek. On the other hand, as the value of `sigma_high` increases, our high-pass filter accentuates the sharper details in the image by filtering out lower frequencies. After experimenting with the `sigma_low/sigma_high` values, I landed on using 12/20 as I believe this showed the hybrid image the best. In our hybrid image, we see the cat clearly and Derek is (for the most part) not visible until we look from a distance. We can also see the effect of our filters by looking at the FFT images; Derek's FFT image shows a narrow band of frequencies whereas the Cat's FFT image accentuates the higher frequency values.

## 2. Hybrid image additional results

*Include*

- At least two additional results (may not use provided samples). For each, include the input and hybrid image (do not need to show filtered or FFT images)

**Original and Hybrid image (Pugflower)**



**Original and Hybrid image (Hedgepig)**



### 3. Image enhancement tasks (2 required, 3 for B&W)

*Include*

- For at least two out of three enhancement tasks (each is worth 10 points), display original image, modified image, and explanation of how the image was modified

#### Color Enhancement:

Original image



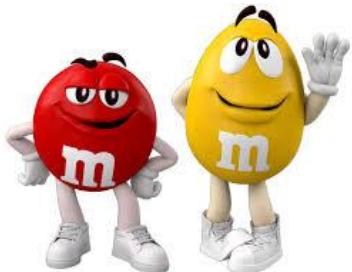
Modified image



The image above was modified by first converting the RGB image to a HSV format. I then got the current saturation of each pixel in the image, and multiplied it by a specific factor (in my case this was 2). After doing this, I then checked if the resulting saturation was in the range of [0, 255]. If it is greater than 255, it is scaled down to 255 as the max. I then converted the image back into RGB format and this was the result. Quite the enhancement.

#### Color Shift:

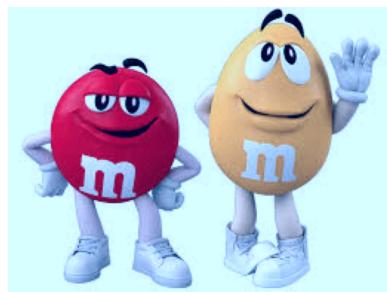
Original image



More red image



Less yellow image



The image above was modified by first converting the RGB image to a LAB format. I then created two images that were copies of the original in LAB format. I then looped through each pixel of the image and got the red value for red copy (A channel) and the yellow value for the yellow copy (B channel) and then multiplied them by factors of 1.25 and 0.75 respectively. This would then increase the redness by a factor of 1.25 and decrease the yellowness by a factor of 0.75. I then converted the images back into RGB format and this was the result. As you can see, the m&m's image looks more red with a red background as white pixels were scaled by 1.25 to create a sort of pinkish background. On the other hand, the less yellow image has a blue background as scaling down the yellowness of the B channel would make the image slightly blue from the initial white background.

#### **4. Quality of results and report**

*Nothing extra to include.*

#### **5. Color hybrid result (B&W)**

**Did not complete**

*Include*

- *Original images, hybrid image*
- *Explanation of method: Is it better to use color for the low-pass, the high-pass, or both?*

#### **6. Gaussian and Laplacian Pyramids (B&W)**

**Did not complete**

*Include*

- *Gaussian pyramid of main hybrid image result (can be one row of images)*
- *Laplacian pyramid of main hybrid image result (another row of images)*

#### **Acknowledgments / Attribution**

*List any sources for code or images from outside sources*

**Images of Derek, and his Cat are from the course website which were provided  
The enhanced picture with the girl swinging is from my camera roll  
The rest of the pictures I used are from the following sources:**

<https://all-americaselections.org/product/sunflower-ring-of-fire/>: flower.jpg

<https://www.smithsonianmag.com/smart-news/secret-life-urban-hedgehogs-180959745/>: hedgehog.jpg

[https://hero.fandom.com/wiki/Red\\_and\\_Yellow](https://hero.fandom.com/wiki/Red_and_Yellow): mnmm.jpg

[https://play.google.com/store/apps/details?id=com.araba.sounds.pig&hl=en\\_GB](https://play.google.com/store/apps/details?id=com.araba.sounds.pig&hl=en_GB): pig.jpg

<https://www.pinterest.com/pin/pug-with-fawn-ears--304978205987709464/>: pug2.jpg