Project 2

Dhruv Kamalesh Kumar
Nuid: 002767429

Short Description:

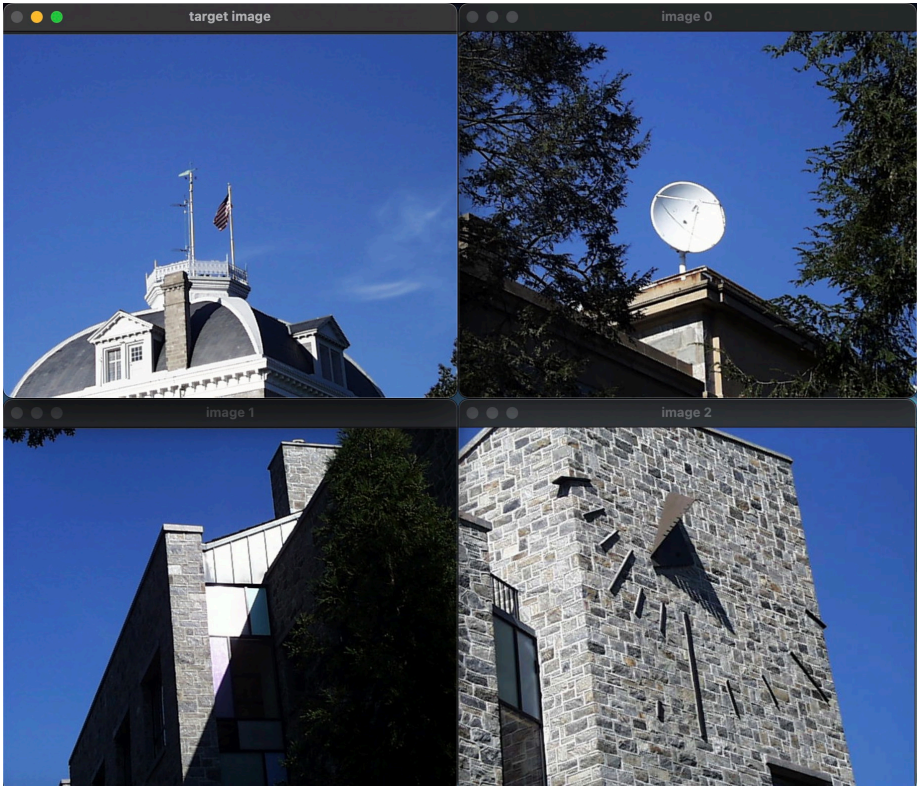
This project was a hands on experience on Content-based Image Retrieval (CBIR). We also learn about feature vectors and distance metric in CBIR. We see how characteristics of an Image can help us categorize them. We make and work with different histograms for different purposes.

Task 1:

This is the result I have obtained using 9x9 square in the middle of the image and using sum-of-squared-difference as distance metric.

We can notice how this approach picks images which have red color in the center(based on target image).

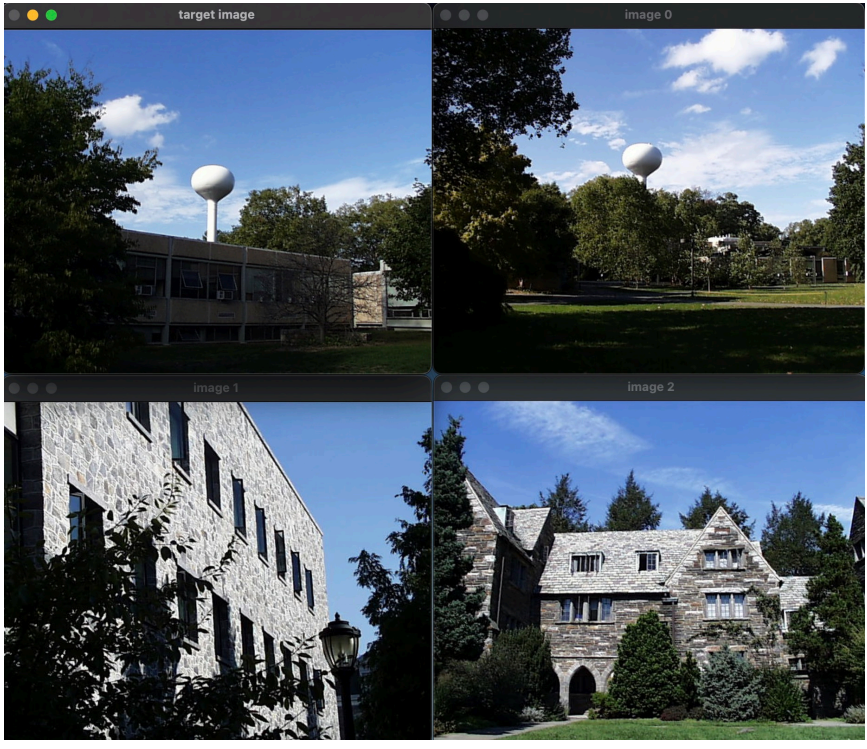
Task 2:



These results for Task 2 were obtained with a whole image RGB histogram using 8 bins for each of RGB and histogram intersection as the distance metric.

We can notice in this case how the color histogram can help us find images with similar color pallet and similar ratios of color.

Task 3:



These results for Task 3 were obtained with two RGB histograms, representing the top and bottom halves of the image, using 8 bins for each of RGB and histogram intersection as the distance metric.

In this approach we can notice how the images are classified by taking histogram information for 2 separate regions and using that as a distance metric.

This checks for similarities in both top and bottom parts of the image independently and then combining the results.

Task 4:

I have used a whole image color histogram and a whole image texture histogram as the feature vector.

For texture metric I have used the Nobel magnitude and used histogram of gradient magnitudes as a texture feature. The distance metric weighs the two types of histogram equally.

From the result we can see how this approach is better than previous approaches, we get better results in terms of matching/finding similar images.

The colors and the textures are more better matched.

Task 5:

So I have decided to train my algorithm to detect deserts, I have downloaded some desert images from https://www.kaggle.com/datasets/akhiljethwa/forest-vs-desert, and added to Olympus data (provided by professor) also I have placed a few training images as a subset.

1.So initially I will design a feature vector such we will take 2 histograms:
   1. 3D color histogram
   2. Histogram of texture of bottom half of the image.

And to design the distance metric:
   1. We will weight the 2 histogram's in such a way that, 75% will be the weight of 2nd histogram (texture since that's where the important data lies) and 25% weight for histogram of whole image.

2. This approach did not give good results so we will try modifying the weights to 80 - 20 split.
But even this did not result it good results, the model is still not giving right results.

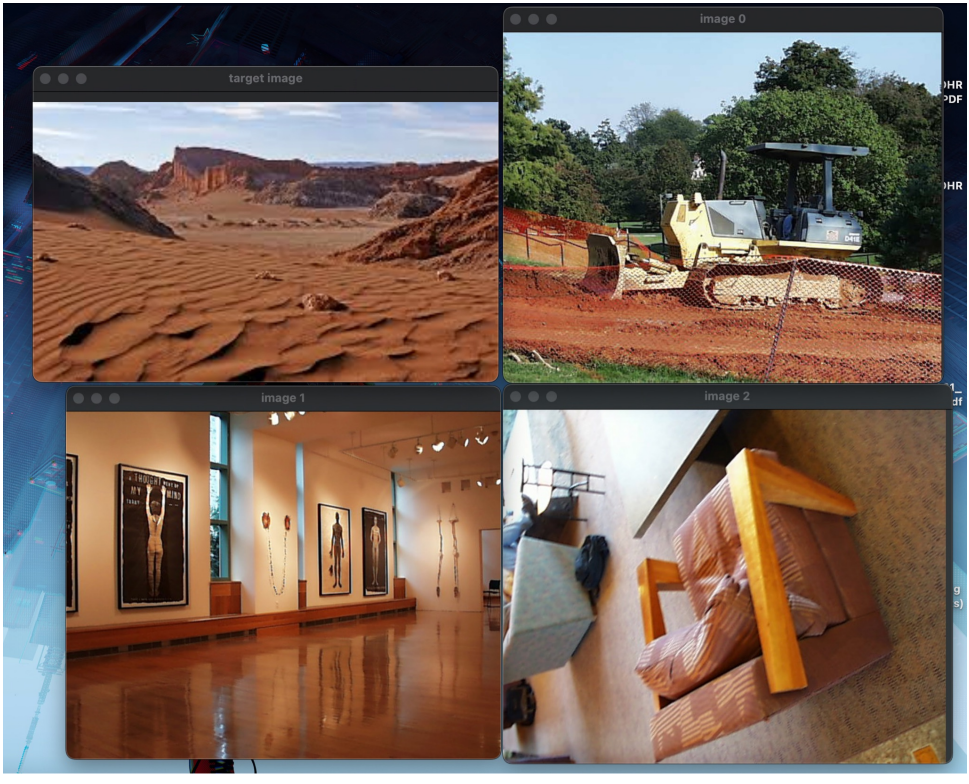
3. Now while making the feature vector we will consider 3D histogram of only common half and not the whole image.

   This also did not result in the right solution.

4 Lets try modifying the weights to 15:85, we got better results on our training data.
   Top 3 results for sample data:
      Image 1: 0.171251
      Image 2: 0.175426
      Image 0: 0.200720

5. Lets see if we can make it better, modifying the weights to 45:55, we got better results on our training data.
   Top 3 results for sample data:
      Image 1: 0.157658
      Image 3: 0.170284
      Image 0: 0.197494

6. Now we run the model on Olympus data set and see the results we get,
   Top Results:
      0.422801
      0.449180
      0.569517

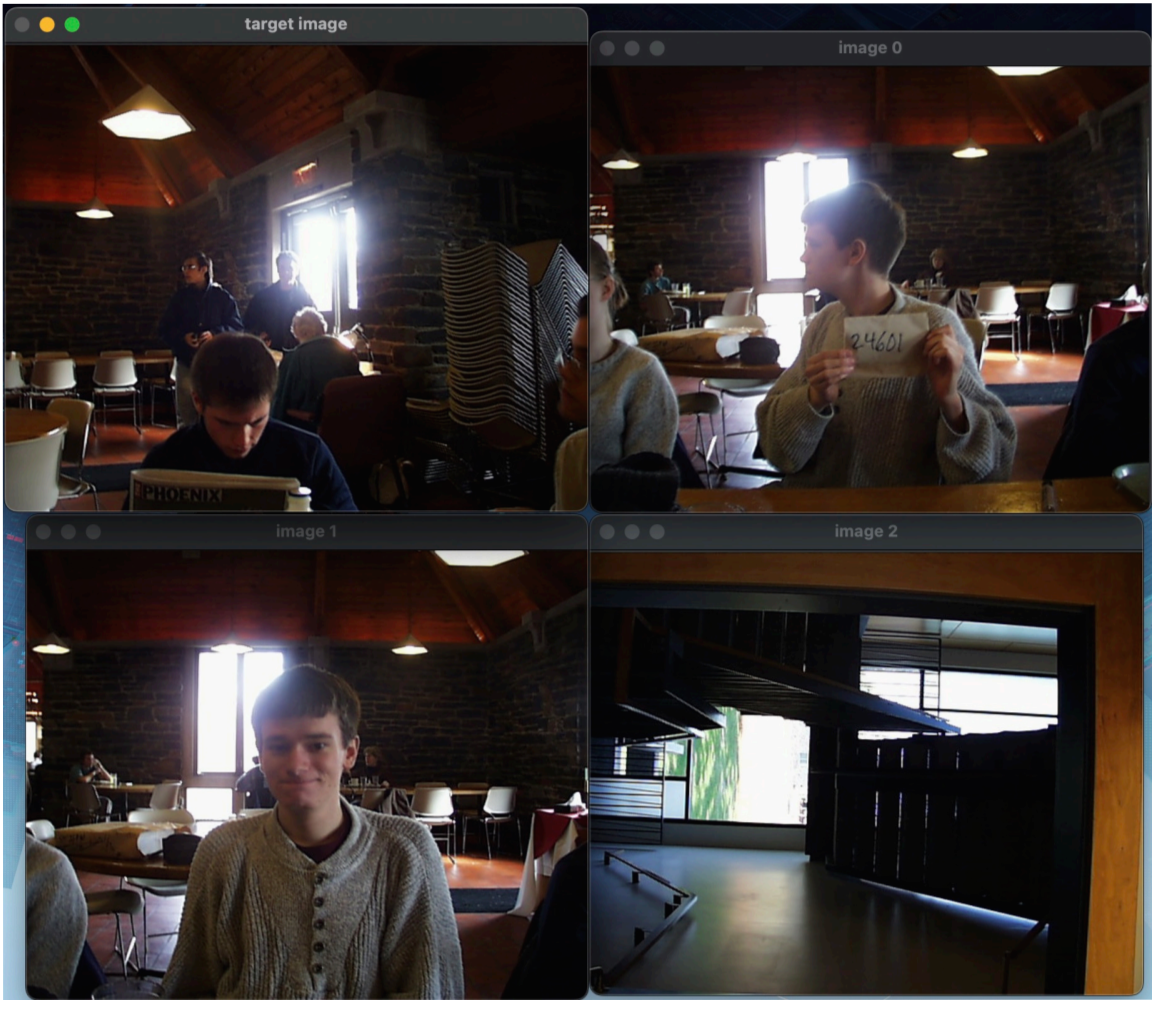


Required Result 5:

As we can see from the above image, the model can do a good job, it is able to detect the color and texture of the target image.

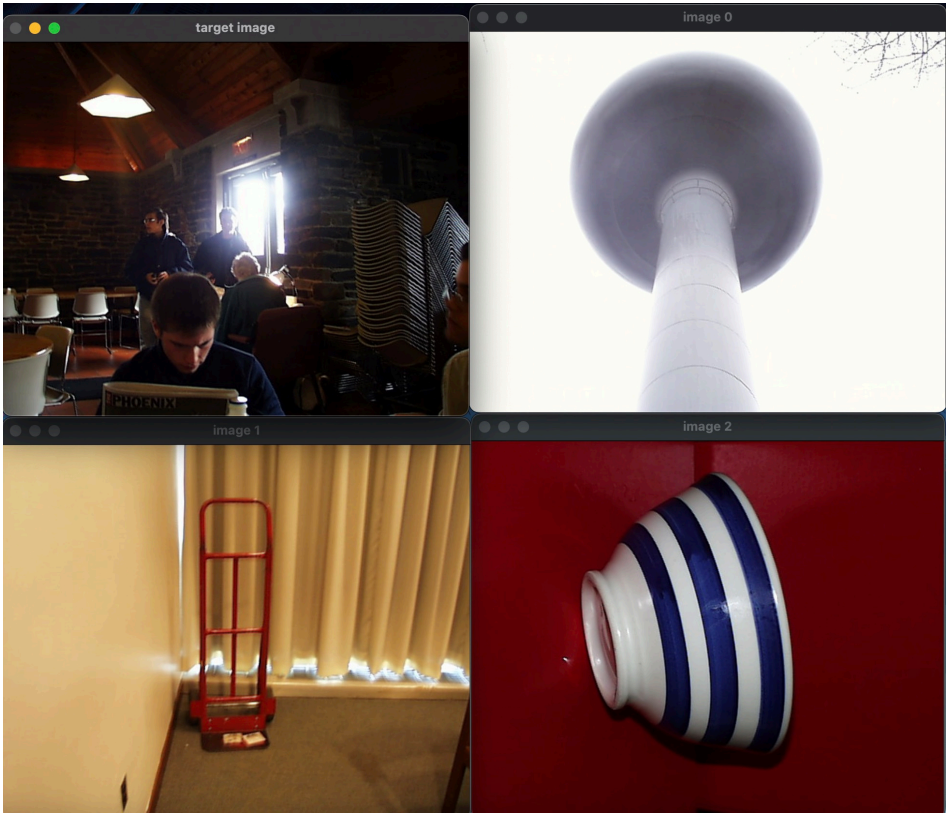
We can notice the brown color being dominant and also finds the texture of the bottom half of the image.

Lets try for a different example,



As we can see the model we designed is good since it was able to detect the new images well.

Lets also try to view the lest similar images,



All the 4 images have nothing in common so that's good.

Things Leant:

1. How to make a histograms, and how histograms work.
2. What are feature vectors and distance metric.
3. How to better choose a feature vector and distance metric.
4. Different types of feature vectors and distance metrics we can make based on the requirement.
5. How adding texture to feature vector can enhance the performance.

Acknowledgement:

1. I have used this beautiful dataset of forest and desert images from https://www.kaggle.com/datasets/akhiljethwa/forest-vs-desert .
2. I have referred to class recordings for some things, but not consulted any person regarding the same.