Project 2: Content Based Image Retrieval

CS 5330: Pattern Recognition and Computer Vision

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Abstract

Project 2 continues in the exploration and demonstration of manipulation and analysis of images at pixel level. This project is based on image retrieval using histograms and channel values.

Experiment

The functionalities that were programmed as part of this project has been described below. This is a brief overview with short explanations and images that demonstrate the effect of these codes.

1. Baseline Matching

A function was coded to do baseline matching of a 9x9 region in the middle of the images. The distance metric used here is the sum of squared distances. Top three matches for the target image are shown in Fig.1.

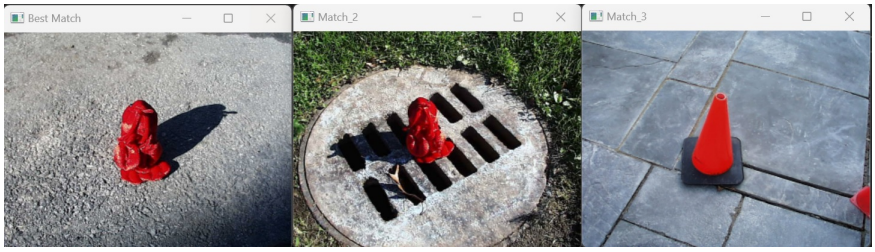

Figure 1: Top three matches. Target same as top match.

2. Histogram matching

Using a histogram of the three channel values, these results were obtained with histogram intersection as a distance metric. The 3D matrix obtained was flattened and normalized before comparing.Top three matches for the target image are shown in Fig.2.

Figure 2: Top three matches. Target same as top match.

3. Multi-Histogram Matching

The top and bottom halves of the image were separately used for obtaining flattened and normalized feature vectors (using the previous histogram function). Using histogram intersection with equal weights assigned to both, the following results were obtained.

Figure 3: Top three matches. Target same as top match.

4. Texture and Color

One feature vector computed here is the colour histogram from earlier. The other feature vector is a histogram of the gradient magnitude of the image obtained from combining the squared sum of the sobel x and y filters for texture.

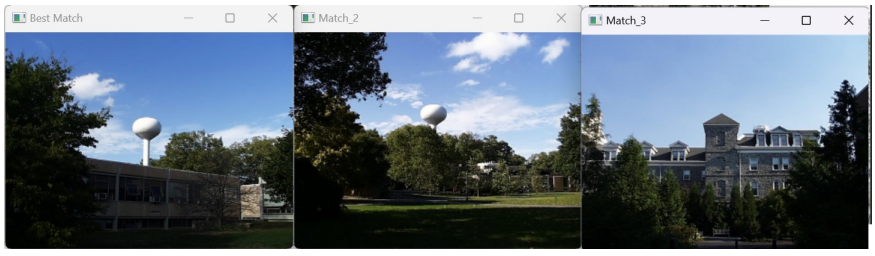

Figure 4: Top three matches. Target same as top match.

5. Custom Design

For the custom design, a colour histogram of the 16x16 center window of the image was computed. For the second feature vector, the texture histogram of the image was used. By assigning different

weights to both the distance metrics (histogram intersection outputs), the following results were obtained.

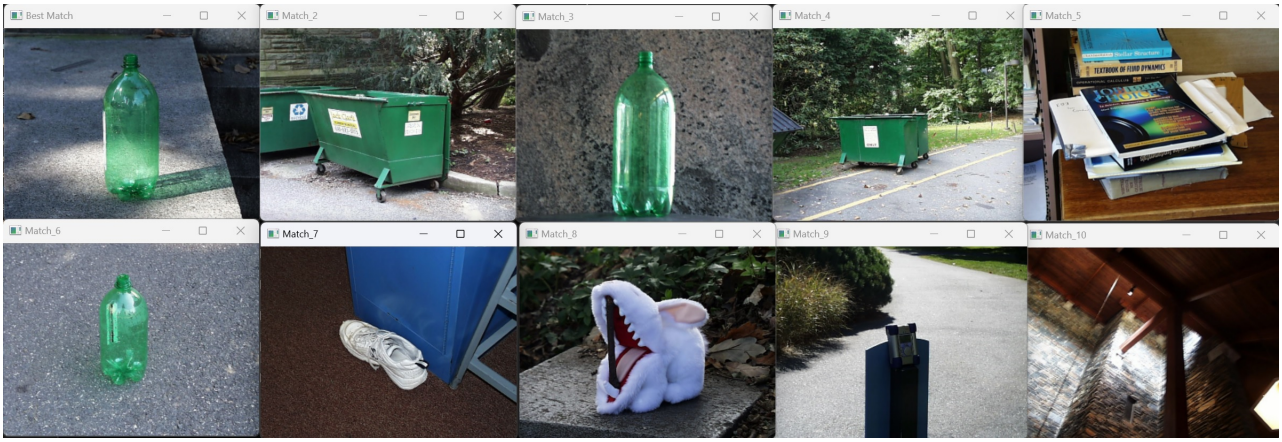

Figure 5: Target image top same as best match. Green bottle.

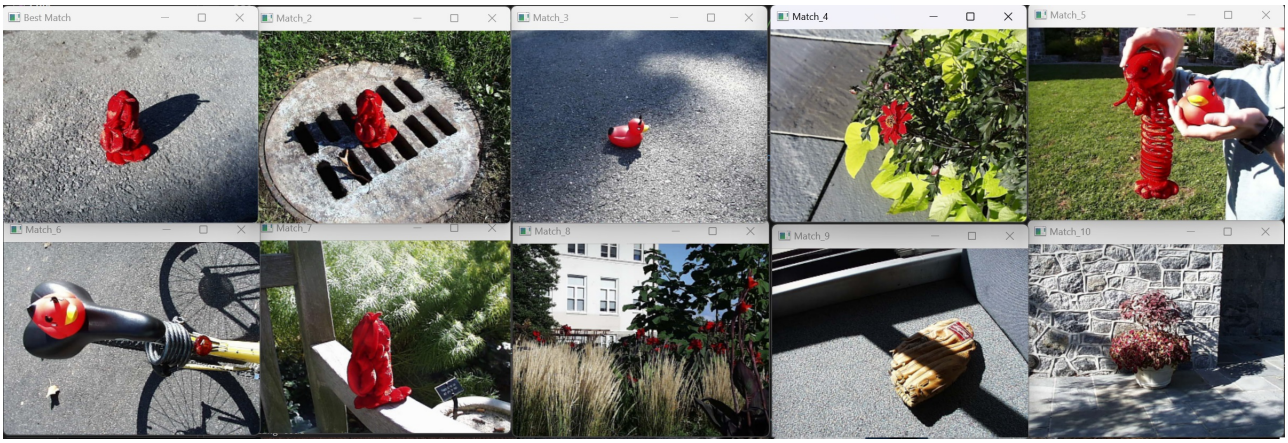

Figure 6: Target image top same as best match. Red object.

Reflections

Though this project, basic usage of OpenCV functions for image access and modification were covered in C++. Some key takeaways for this project were:

- Portability of previously created functions and usage of these in content based retrieval.
- Different methods of comparing and figuring out how images can be related with just manipulation of pixel values and edge filters.
- The usage and computation of vectors for feature storage was new. This also lays the foundation and has given me an idea of how image retrieval occurs and can be meshed with machine learning.

References

[1] https://docs.opencv.org/

[2] Winnemöller, H., Olsen, S.C. and Gooch, B., 2006. Real-time video abstraction. ACM Transactions On Graphics (TOG), 25(3), pp.1221-1226.

[3] https://pyimagesearch.com/2021/05/12/image-gradients-with-opencv-sobel-and-scharr/