

CS510 - Assignment 2: Template Matching
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Overview:

For Assignment 2, "Template Matching" we were tasked with experimenting with template matching and seeing based on 6 methods had the best results. The 6 methods we experimented with were TM_CCOEFF: Template Matching Correlation Coefficient, TM_CCOEFF_NORMED, TM_CCORR: Template Matching Correlation, TM_CCORR_NORMED, TM_SQDIFF: Template Matching Square Difference, TM_SQDIFF_NORMED. Out of these 6 methods, TM_CCOEFF worked the best for our results. We tried this with various different objects including a ceramic penguin, a baby yoda figurine and a water bottle. When comparing these, as shown in Figure 1 and Figure 2, it shows that TM_CCOEFF detected more often, especially in variant poses.

TM_CCOEFF (Template Matching Correlation):

By far the TM_CCOEFF method was the best in our experimental results. This was surprising to us as the method for this implemented in OpenCV is fairly simple. This method does template matching by first taking the template image and zero means it. After this, the darker areas of the image are represented by negative values and the brighter areas of the image are represented with positive values ["Template Matching." *OpenCV*]. The math behind this can be seen in Figure 3, where T denotes the template, I the image and R the result. For here it is a simple template matching procedure. When the bright parts of the template and the image overlap, we see positive values in a dot product, and the opposite for dark values. This essentially means that this method measures where the brightest set of pixels in the image match with the same shape as the template [B., Rene]. Since this is such a simple method, we believe that having the striking contrast for our images helped. This can be seen with the penguin's abdomen and how it is brighter than the rest of the image. However, that being said this method and all of the other methods were picky in matching. The object used had to be in the exact size and rotation as the template for it to work. Due to this, we believe that template matching is not the best suited for image matching especially in a given environment where the object in question can be moved in subtle ways.

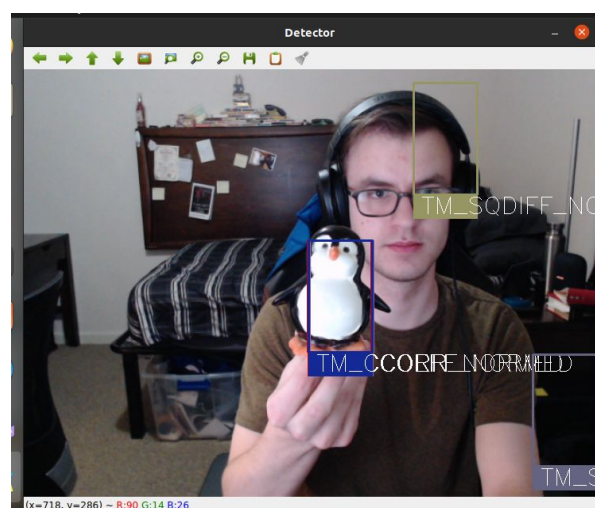


Figure 1: Portrait Penguin

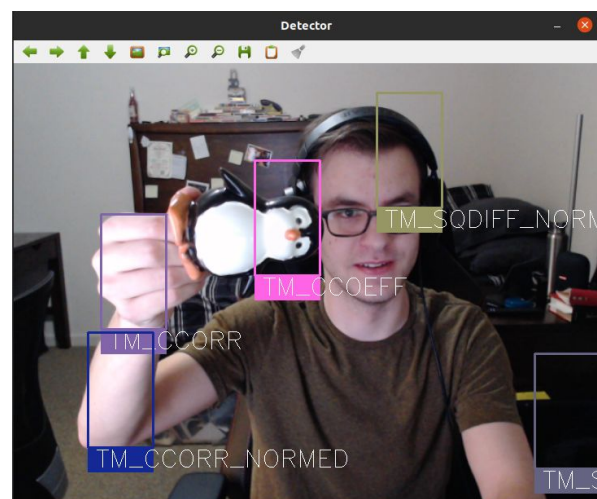


Figure 2: Landscape Penguin

$$R(x, y) = \sum_{x', y'} (T'(x', y') \cdot I'(x + x', y + y'))$$

Figure 3: TM_CCOEFF Equation

References:

"Template Matching." *OpenCV*, docs.opencv.org/3.4/de/da9/tutorial_template_matching.html.

B., Rene, et al. "What Does the TM_CCORR and TM_CCOEFF in Opencv Mean?" *Stack Overflow*, 1 Feb. 1968, stackoverflow.com/questions/55469431/what-does-the-tm-ccorr-and-tm-ccoeff-in-opencv-mean.