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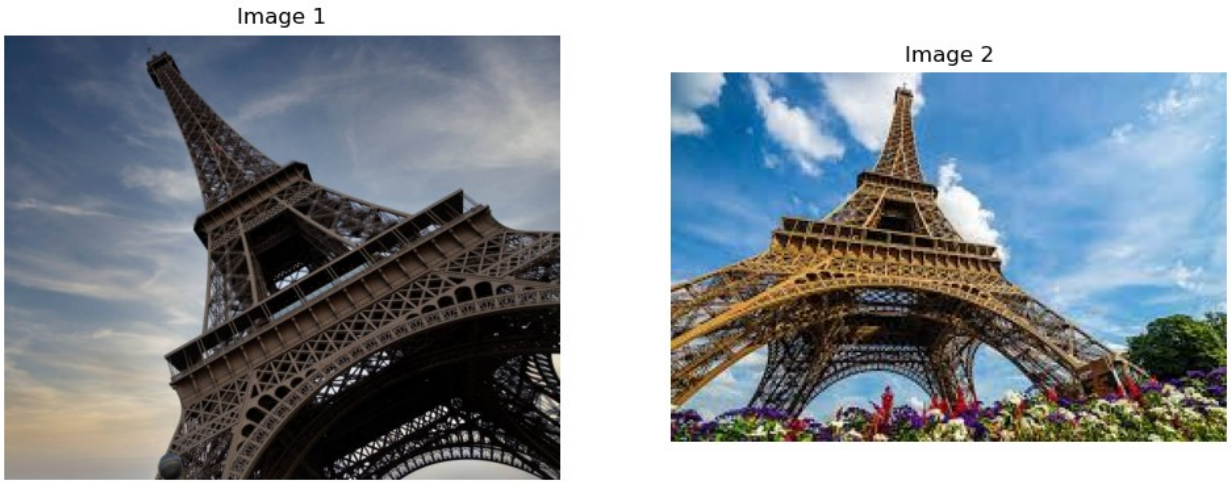
Batch : A4-67

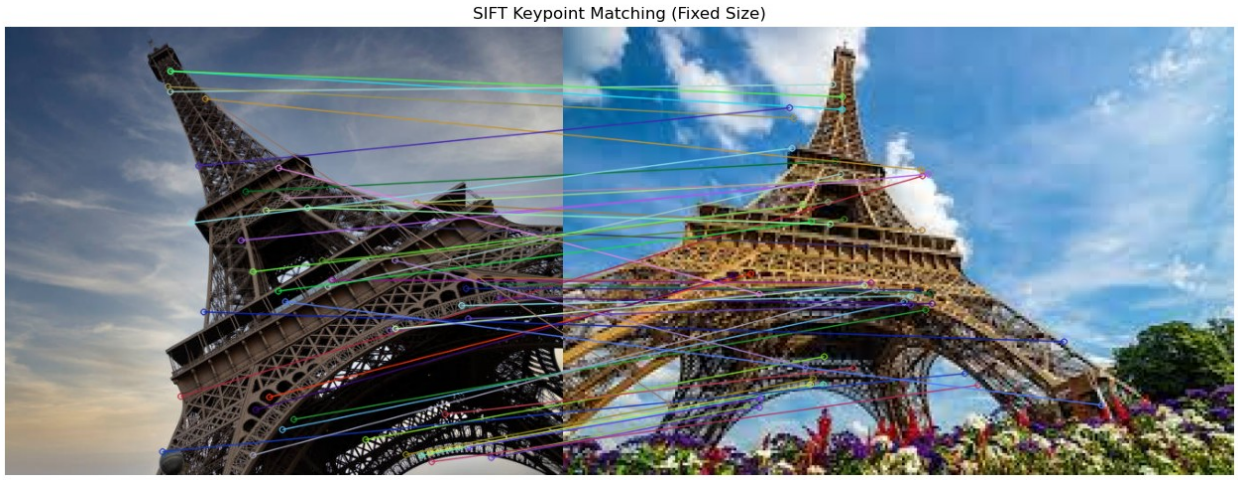
Subject : TA2

1. SIFT Feature Detection and Matching

```
import cv2
import matplotlib.pyplot as plt

def resize_to_same_height(img1, img2):
    h1 = img1.shape[0]
    h2 = img2.shape[0]
    if h1 != h2:
        scale = h1 / h2
        new_w = int(img2.shape[1] * scale)
        img2 = cv2.resize(img2, (new_w, h1),
interpolation=cv2.INTER_AREA)
    return img2

def detect_and_match_sift(img1_path, img2_path):
    img1 = cv2.imread(img1_path)
    img2 = cv2.imread(img2_path)

    if img1 is None or img2 is None:
        print("Error: One or both image paths are incorrect.")
        return

    gray1 = cv2.cvtColor(img1, cv2.COLOR_BGR2GRAY)
    gray2 = cv2.cvtColor(img2, cv2.COLOR_BGR2GRAY)

    plt.figure(figsize=(12, 6))
    plt.subplot(1, 2, 1)
    plt.imshow(cv2.cvtColor(img1, cv2.COLOR_BGR2RGB))
    plt.title('Image 1')
    plt.axis('off')

    plt.subplot(1, 2, 2)
    plt.imshow(cv2.cvtColor(img2, cv2.COLOR_BGR2RGB))
    plt.title('Image 2')
    plt.axis('off')

    plt.suptitle('Original Images', fontsize=16)
    plt.show()

    sift = cv2.SIFT_create()
    keypoints1, descriptors1 = sift.detectAndCompute(gray1, None)
```

```
    keypoints2, descriptors2 = sift.detectAndCompute(gray2, None)

    img2_resized = resize_to_same_height(img1, img2)
    gray2_resized = cv2.cvtColor(img2_resized, cv2.COLOR_BGR2GRAY)
    keypoints2, descriptors2 = sift.detectAndCompute(gray2_resized,
None)

    bf = cv2.BFMatcher(cv2.NORM_L2, crossCheck=True)
    matches = bf.match(descriptors1, descriptors2)
    matches = sorted(matches, key=lambda x: x.distance)

    matched_img = cv2.drawMatches(img1, keypoints1, img2_resized,
keypoints2, matches[:50], None,

flags=cv2.DrawMatchesFlags_NOT_DRAW_SINGLE_POINTS)

    plt.figure(figsize=(16, 8))
    plt.imshow(cv2.cvtColor(matched_img, cv2.COLOR_BGR2RGB))
    plt.axis('off')
    plt.title('SIFT Keypoint Matching (Fixed Size)')
    plt.show()

detect_and_match_sift('img1.jpg', 'img2.jpg')
```

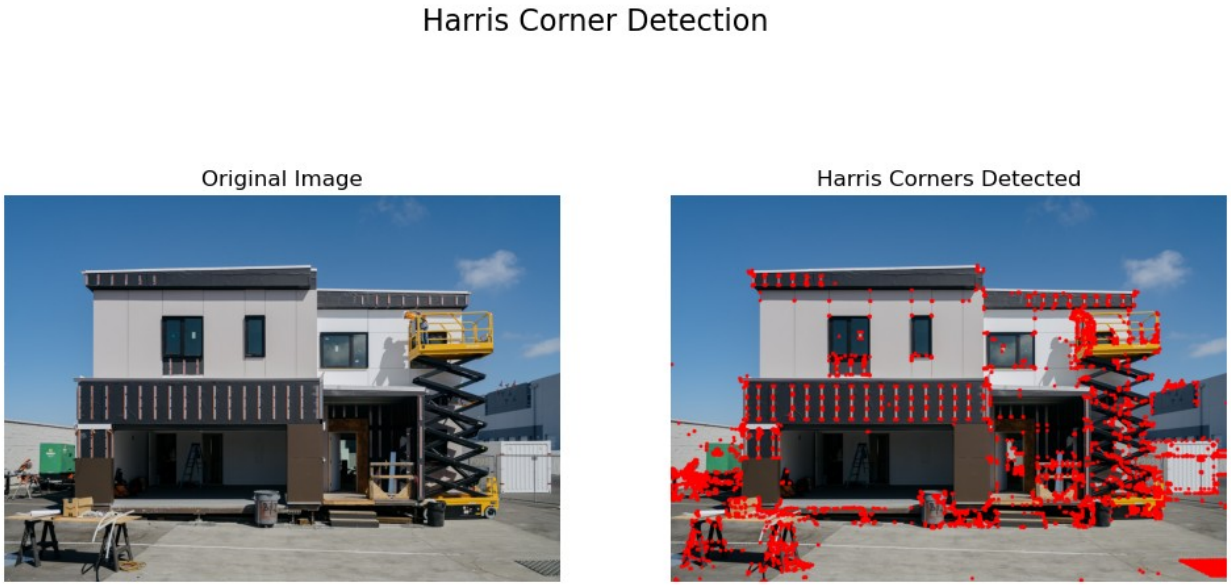




2. Harris Corner Detector

```
import cv2
import numpy as np
import matplotlib.pyplot as plt

def harris_corner_detection(img_path):
    img = cv2.imread(img_path)
    if img is None:
        print("Error: Image path is incorrect.")
        return

    gray = cv2.cvtColor(img, cv2.COLOR_BGR2GRAY)
    gray = np.float32(gray)

    dst = cv2.cornerHarris(gray, blockSize=2, ksize=3, k=0.04)
    dst = cv2.dilate(dst, None)

    img_with_corners = img.copy()
    threshold = 0.01 * dst.max()
    corners = np.argwhere(dst > threshold)

    for y, x in corners:
        cv2.circle(img_with_corners, (x, y), radius=5, color=(0, 0,
255), thickness=-1)

    plt.figure(figsize=(12, 6))
    plt.subplot(1, 2, 1)
    plt.imshow(cv2.cvtColor(img, cv2.COLOR_BGR2RGB))
    plt.title('Original Image')
    plt.axis('off')

    plt.subplot(1, 2, 2)
    plt.imshow(cv2.cvtColor(img_with_corners, cv2.COLOR_BGR2RGB))
    plt.title('Harris Corners Detected')
```

```
    plt.axis('off')

    plt.suptitle('Harris Corner Detection', fontsize=16)
    plt.show()

harris_corner_detection('Harris.jpg')
```

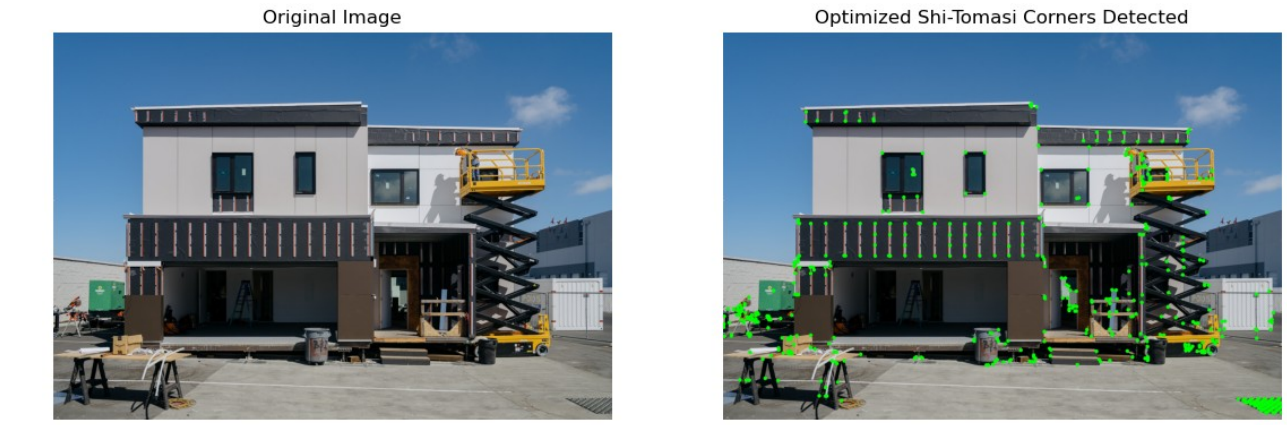


3 Shi-Tomasi corner detection

```
import cv2
import numpy as np
import matplotlib.pyplot as plt

def shi_tomasi_corner_detection(img_path):
    img = cv2.imread('Harris.jpg')
    if img is None:
        print("Error: Image path is incorrect.")
        return

    gray = cv2.cvtColor(img, cv2.COLOR_BGR2GRAY)

    corners = cv2.goodFeaturesToTrack(
        gray,
        maxCorners=500,
        qualityLevel=0.001,
        minDistance=5,
        blockSize=7
    )

    if corners is not None:
        corners = np.int0(corners)
```

```
        img_with_corners = img.copy()
        for i in corners:
            x, y = i.ravel()
            cv2.circle(img_with_corners, (x, y), radius=7, color=(0,
255, 0), thickness=-1)
    else:
        print("No corners detected.")
        return

    plt.figure(figsize=(14, 7))
    plt.subplot(1, 2, 1)
    plt.imshow(cv2.cvtColor(img, cv2.COLOR_BGR2RGB))
    plt.title('Original Image')
    plt.axis('off')

    plt.subplot(1, 2, 2)
    plt.imshow(cv2.cvtColor(img_with_corners, cv2.COLOR_BGR2RGB))
    plt.title('Optimized Shi-Tomasi Corners Detected')
    plt.axis('off')

    plt.suptitle('Shi-Tomasi Corner Detection (Optimized)',
fontsize=18)
    plt.show()

shi_tomasi_corner_detection('Harris.jpg')
```

```
C:\Users\Asus\AppData\Local\Temp\ipykernel_24308\1213672758.py:22:
DeprecationWarning: `np.int0` is a deprecated alias for `np.intp`.
(Deprecated NumPy 1.24)
  corners = np.int0(corners)
```



Conclusion

During my experiment with the test image, I changed certain parameter values and observed the following effects:

1. SIFT Feature Matching

- **Initial Ratio Threshold:** 0.75
- **Changed to:** 0.80
- **Observation:** Increasing the ratio threshold resulted in more matches, but also introduced more false matches, reducing accuracy. Lowering it to 0.70 reduced false matches but also missed some valid key points.

2. Harris Corner Detection

- **Initial Sensitivity Factor (k):** 0.04
- **Changed to:** 0.05
- **Observation:** Increasing the sensitivity factor detected fewer corners, missing some edges. When reduced to 0.03, more corners were detected, but there was noise and false detections.
- **Initial Block Size:** 3
- **Changed to:** 4
- **Observation:** A larger block size resulted in more robust corner detection but missed finer details. Reducing it to 2 detected more corners but introduced noise.

3. Shi-Tomasi Corner Detection

- **Initial Quality Level:** 0.01
- **Changed to:** 0.015
- **Observation:** Increasing the quality level reduced the number of detected corners, keeping only the strongest ones. Lowering it to 0.005 detected more corners, but some were false detections.
- **Initial Minimum Distance:** 10

- **Changed to:** 8

- **Observation:** Reducing the minimum distance resulted in more clustered corner detections, leading to redundancy. Increasing it to 12 spaced out the detected corners but missed some important key points.

Final Insight

I observed that adjusting these parameters significantly impacted the accuracy of feature detection and corner detection. Fine-tuning these values is necessary for optimal results, depending on the application.