EX.NO.: 03
DATE: 23.06.2025

POINT DETECTION AND PERFORMANCE COMPARISON

AIM

To implement and compare the performance of three point detection algorithms—**Harris Corner Detector**, **Shi-Tomasi Corner Detector**, and **SIFT Detector**—based on the number of keypoints detected and their execution time.

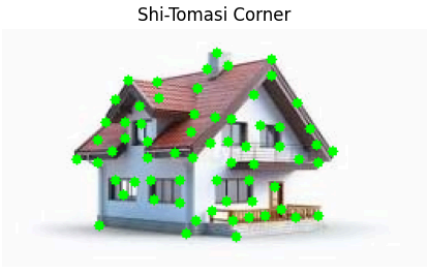
ALGORITHM

1. Load the input image and convert it to grayscale.
2. Apply Harris Corner Detection and record the number of corners detected and execution time.
3. Apply Shi-Tomasi Corner Detection and record the number of corners detected and execution time.
4. Apply SIFT Keypoint Detection and record the number of keypoints detected and execution time.
5. Plot bar charts to compare the number of detected points and execution time for each method.
6. Display the performance comparison and print the numerical values for clarity.

CODE AND OUTPUT

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

# Load image
img = cv2.imread('image3.jpg')
gray = cv2.cvtColor(img, cv2.COLOR_BGR2GRAY)

# === 1. Harris Corner Detector ===
start = time.time()
harris = cv2.cornerHarris(np.float32(gray), blockSize=2, ksize=3, k=0.04)
harris = cv2.dilate(harris, None)
harris_img = img.copy()
harris_img[harris > 0.01 * harris.max()] = [0, 0, 255]  # Mark corners in red
harris_time = time.time() - start

# === 2. Shi-Tomasi Corner Detector ===
start = time.time()
shi_corners = cv2.goodFeaturesToTrack(gray, maxCorners=100, qualityLevel=0.01,
minDistance=10)
shi_img = img.copy()
if shi_corners is not None:
    for c in shi_corners:
        x, y = c.ravel()
        cv2.circle(shi_img, (int(x), int(y)), 3, (0, 255, 0), -1)  # Green
shi_time = time.time() - start

# === 3. SIFT Detector ===
start = time.time()
sift = cv2.SIFT_create()
```

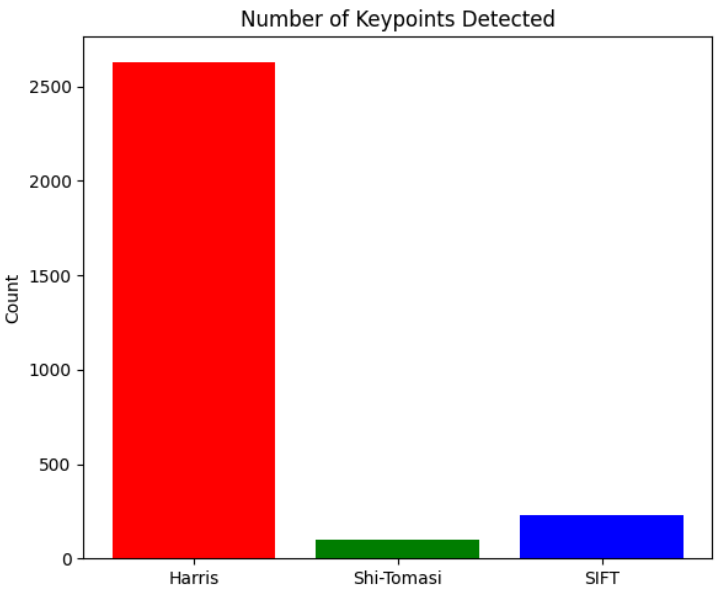
```
keypoints = sift.detect(gray, None)
sift_img = cv2.drawKeypoints(img, keypoints, None,
flags=cv2.DRAW_MATCHES_FLAGS_DRAW_RICH_KEYPOINTS)
sift_time = time.time() - start

# === Display the results ===
titles = ['Harris Corner', 'Shi-Tomasi Corner', 'SIFT Keypoints']
images = [harris_img, shi_img, sift_img]

plt.figure(figsize=(18, 6))
for i in range(3):
    plt.subplot(1, 3, i + 1)
    plt.imshow(cv2.cvtColor(images[i], cv2.COLOR_BGR2RGB))
    plt.title(f"{titles[i]}")
    plt.axis('off')
plt.show()

# === Print Performance Metrics ===
print(f"Harris Detector: {np.sum(harris > 0.01 * harris.max())} points, Time:
{harris_time:.4f}s")
print(f"Shi-Tomasi Detector: {len(shi_corners)} points, Time: {shi_time:.4f}s")
print(f"SIFT Detector: {len(keypoints)} keypoints, Time: {sift_time:.4f}s")
```




```
Harris Detector: 2090 points, Time: 0.0020s
Shi-Tomasi Detector: 65 points, Time: 0.0000s
SIFT Detector: 196 keypoints, Time: 0.0141s
```

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

# Load Image
img = cv2.imread('image1.jpg')
gray = cv2.cvtColor(img, cv2.COLOR_BGR2GRAY)

# === 1. Harris Corner Detector ===
start = time.time()
harris = cv2.cornerHarris(np.float32(gray), blockSize=2, ksize=3, k=0.04)
harris = cv2.dilate(harris, None)
harris_points = np.sum(harris > 0.01 * harris.max())  # Approximate point count
harris_time = time.time() - start
```

```
# === 2. Shi-Tomasi Corner Detector ===
start = time.time()
shi_corners = cv2.goodFeaturesToTrack(gray, maxCorners=100, qualityLevel=0.01,
minDistance=10)
shi_points = len(shi_corners) if shi_corners is not None else 0
shi_time = time.time() - start

# === 3. SIFT Detector ===
start = time.time()
sift = cv2.SIFT_create()
keypoints = sift.detect(gray, None)
sift_points = len(keypoints)
sift_time = time.time() - start

# === Data for Chart ===
detectors = ['Harris', 'Shi-Tomasi', 'SIFT']
keypoints_count = [harris_points, shi_points, sift_points]
execution_time = [harris_time, shi_time, sift_time]

# === Plot Keypoints Detected ===
plt.figure(figsize=(12, 5))

plt.subplot(1, 2, 1)
plt.bar(detectors, keypoints_count, color=['red', 'green', 'blue'])
plt.title('Number of Keypoints Detected')
plt.ylabel('Count')

# === Plot Execution Time ===
plt.subplot(1, 2, 2)
plt.bar(detectors, execution_time, color=['red', 'green', 'blue'])
plt.title('Execution Time Comparison')
plt.ylabel('Time (seconds)')

plt.tight_layout()
plt.show()

# === Print for clarity ===
print(f"Harris: {harris_points} points, Time: {harris_time:.4f} sec")
print(f"Shi-Tomasi: {shi_points} points, Time: {shi_time:.4f} sec")
print(f"SIFT: {sift_points} points, Time: {sift_time:.4f} sec")
```



INFERENCE

Harris and Shi-Tomasi detectors are fast and suitable for simple corner detection tasks, while SIFT provides more robust and distinctive features but requires higher computation time. The comparison helps in choosing an appropriate detector based on accuracy and speed requirements.