Computer Vision Laboratory – Lab 3

Objective:
The objective of this experiment is to explore and implement advanced image processing techniques using OpenCV and scikit-image libraries. The experiment focuses on blob detection, Harris corner detection, image pyramids, and Gabor filter banks to understand feature detection and multi-scale image analysis.

Theory:

1. Blob Detection:
Blob detection identifies regions in an image that differ in intensity compared to surrounding regions. The Laplacian of Gaussian (LoG) method is commonly used, which detects blobs by finding extrema in scale-space.

2. Harris Corner Detection:
Harris corner detection identifies points in an image where intensity changes significantly in all directions. It is based on the eigenvalues of the second moment matrix and is widely used for feature extraction.

3. Image Pyramids:
Image pyramids are multi-scale representations of images. Gaussian pyramids reduce image resolution, while Laplacian pyramids capture edge information between pyramid levels.

4. Gabor Filter Banks:
Gabor filters are linear filters used for texture analysis. They are sensitive to specific frequencies and orientations, making them suitable for feature extraction in vision tasks.

Procedure:
1. Load the input image using OpenCV.
2. Convert the image to grayscale.
3. Apply Laplacian of Gaussian for blob detection.
4. Use Harris corner detection to identify corner points.
5. Construct Gaussian and Laplacian image pyramids.
6. Apply multiple Gabor filters with varying frequencies and orientations.
7. Visualize and analyze the outputs.

Observations:
- Blob detection successfully highlighted circular regions in the image.
- Harris corner detection accurately marked high-intensity corner points.
- Gaussian pyramids progressively reduced image size and detail.
- Laplacian pyramids preserved edge information.
- Gabor filters effectively captured texture patterns at different orientations.

Result:
All objectives of CV Lab-3 were successfully achieved. The experiment demonstrated the effectiveness of OpenCV and scikit-image functions for feature detection, multi-scale analysis, and texture extraction.