Indian Institute of Science Education and Research
Bhopal

Computer Vision(DSE/EECS-312)

Assignment-1

Deadline: 12-09-2024, 11:59 PM Max mark: 18

Please follow the instructions carefully.

1. **All questions are mandatory. Plagiarism and copying from anywhere (similar submission) can debar you from this course and invite the academic dishonesty policy.**
2. **Implement all algorithms purely in Python without using specialized libraries like OpenCV or PIL for the processing. You may use libraries for basic operations (like loading an image), but the algorithms themselves should be coded from scratch.**
3. **Comment on your code extensively to explain your logic and the steps you are implementing.**
4. **Display both the original and processed images to compare results.**
5. **Make a short 7-minute video and explain your code.**
6. **A report reflecting on what you have learned. Visualization of the output must be there along with other necessary details.**

1. Apply the filters mentioned below on the image attached and analyze their impact. Describe what you found after applying each filter and why certain phenomena are happening. ***(Marks: 6)***

1.

-1	0	1
-1	0	1
-1	0	1

2.

1	1	1
0	0	0
-1	-1	-1

Since the above filters are of dimension 3×3. Construct the same filters of dimension 5×5 and do the above experiments.

2. Sobel Edge Detection Implementation. ***(Marks: 6)***
   (a) Write a Python function to apply the Sobel filter given below to detect edges along the x-direction and y-direction. Combine these to compute the gradient magnitude image.

1.

-1	0	1
-2	0	2
-1	0	1

2.

1	2	1
0	0	0
-1	-2	-1

3.

1	2	3	2	1
2	3	5	3	2
0	0	0	0	0
-2	-3	-5	-3	-2
-1	-2	-3	-2	-1

4.

-1	-2	0	2	1
-2	-3	0	3	2
-3	-5	0	5	3
-2	-3	0	3	2
-1	-2	0	2	1

(b) Apply your function to an image and display the gradient magnitude image alongside the original. Vary the size of the kernel and document the effects.

(c) Manually implement thresholding on the gradient magnitude to create a binary edge image. Experiment with different thresholds and show the results.

(d) Apply the Sobel edge detector on a noisy image (you may add synthetic noise to an attached clean image). Discuss how noise affects edge detection and the visual quality of the output images.

3. Laplacian of Gaussian Edge Detection (follow the class notes to choose filters). ***(Marks: 6)***

(a) Implement Gaussian smoothing from scratch. Apply your Gaussian filter given below to smooth an image before edge detection.

(b) Develop the Laplacian filter and apply it to the smoothed image from 3 (a) to detect edges via zero-crossings. Describe how you detect zero-crossings in your implementation.

(c) Display the edges detected from the smoothed image alongside the edges detected from the non-smoothed image. Discuss the differences and the impact of noise.

Best wishes