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CSCE 689 Computational Photography
Report on Assignment 4

I. Overview

The objective is to perform image refocusing and aperture changes in light field images through operations like shifting and averaging.

II. Deliverables

The contents of the submission have the following:

Code\	Directory containing the python source file : main.py
Report_430000753_RizuJain.pdf	This report.
Images\	Blank Directory, should contain input images The input images should be named 'LF_01.png' and 'LF_02.png'
Results\	Blank Directory. Output images are saved here upon execution of program

III. Setup

The assignment was developed in the following environment:

- Host OS: Windows 10
- IDE: Spyder (Python 3.7)

IV. Task 1: Extract images from view points

This task is implemented in the function:

```
def get_view(src_img, block_size, view_point):
      …
    return img_view.copy()
```

get_view() function takes the image, angular resolution and view co-ordinates and returns the view image.

The algorithm goes as follows:

1. Prepare an array of integers from 0 to size of image in dimension
2. Modulo elements with the angular resolution
3. Select the element based on view index in that dimension
4. Use this to select pixels from the original light field image

Results Task 1:

LF_01 – View (1,1)	LF_01 – View (1,7)
	
LF_01 – View (7,1)	LF_01 – View (7,7)
	

LF_02 – View (1,1)	LF_02 – View (1,7)
	
LF_02 – View (7,1)	LF_02 – View (7,7)
	

V. Task 2: Aperture adjustment

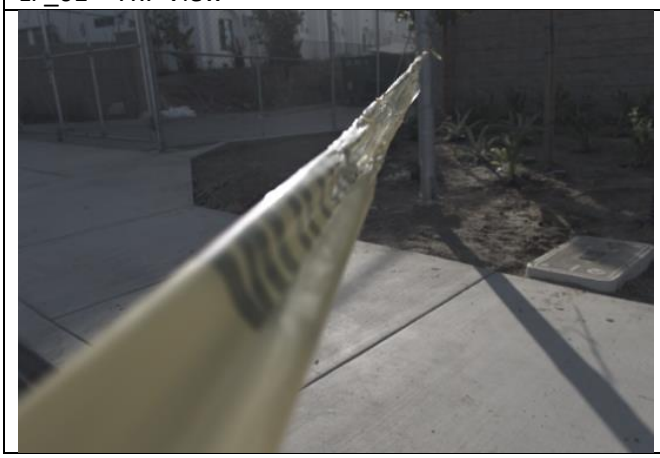
This task is implemented under section "# task 2" in the code:

```
# task 2
apertures = [3, 2, 1, 0]

for aper in apertures:
    aper_img = np.zeros(
        (int(lf_image.shape[0]/block_size), int(lf_image.shape[1]/block_size), 3))
    count = 0

    for i in range(-aper, aper+1):
        for j in range(-aper, aper+1):
            aper_img += get_view(lf_image, 7, (i+4, j+4))
            count += 1

    aper_img = aper_img / count
    aper_name = "aper_"+str((aper*2)+1)+"_"
    plt.imsave(res_dir+aper_name+image, aper_img)
```

To generate the aperture images:

1. Select the aperture size
2. Prepare a zeros array using light field image shape and angular resolution
3. For each aperture, get different view images using the *get_view()* function developed in Task 1
4. Average these view images to get the final image

Task 2 Results:

LF_01 – 7x7 View	LF_01 – Central 5x5 View
	

LF_01 – Central 3x3 View	LF_01 – Central 1x1 view
	

LF_02 – 7x7 View	LF_02 – Central 5x5 View
	
LF_02 – Central 3x3 View	LF_02 – Central 1x1 view
	

VI. Task 3: Refocus images

This task is implemented in "# task 3" section of the code:

```
# task 3
ds = range(-2, 3)

for d in ds:
    img_re = np.zeros(
        (int(lf_image.shape[0]/block_size), int(lf_image.shape[1]/block_size), 3))

    for i in range(1, 8):
        for j in range(1, 8):
            img_temp = get_view(lf_image, 7, (i, j))
            di = (i-4) * d
            dj = (j-4) * d
            img_temp_roll = np.roll(img_temp, (di, dj), (0, 1))
            img_re += img_temp_roll

    img_re = img_re / 49
    re_name = "refocus_d"+str(d)+"_"
    plt.imsave(res_dir+re_name+image, img_re)
```

To get the refocus images:

1. Generate a zero initialized image as a placeholder
2. Loop over all the 49 sub-images obtained using *get_view()*
3. Compute the shift for each image using d and their view points
4. Use np.roll to shift the image in x and y directions
5. Add the shifted image to the place holder
6. Average the place holder and save it

Task 3 Results:

LF_01: Refocus D = -2	LF_01: Refocus D = -1
	
LF_01: Refocus D = 0	**LF_01: Refocus D = 1**
	
LF_01: Refocus D = 2	
	

LF_02: Refocus D = -2	LF_02: Refocus D = -1
	
LF_02: Refocus D = 0	LF_02: Refocus D = 1
	
LF_02: Refocus D = 2	
	

VII. References

1. https://inst.eecs.berkeley.edu/~cs194-26/fa16/Lectures/light_fields.pdf

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