Computer Vision Homework #4

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Robot Vision Lab (Room 1421)

Homework Assignment

- 2023/10/03 – Homework 1 assigned, due 10/17
- 2023/11/07 – Homework 2 assigned, due 11/21
- 2023/11/28 – Homework 3 assigned, due 12/12
- 2023/12/19 – Homework 4 assigned, due 01/02

Homework 4

Active Contour

There are three functions that you need to implement.

1. Set initial points (Q1)
2. Find the contour (Q2)
3. Save the result videos (Q3)

There are totally 3 test images.

For each test image, you will get 1 result image and 1 result video.

Note:

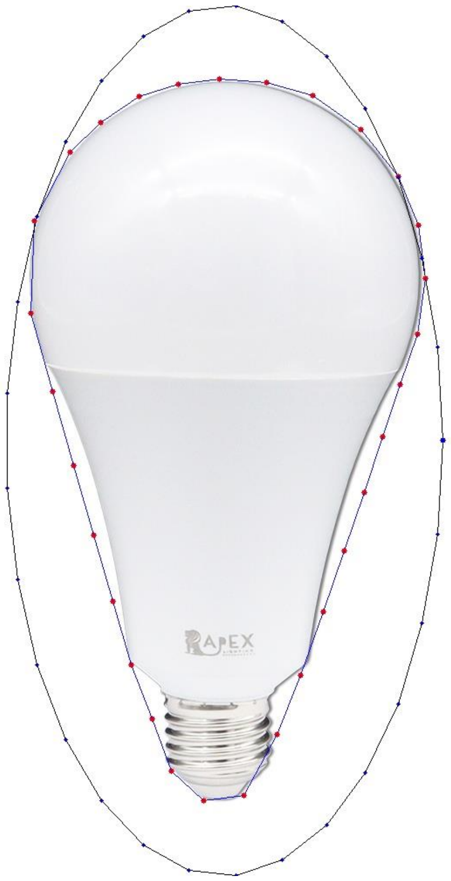
You are allowed to use library to draw points/lines and to generate the videos

img1.jpg

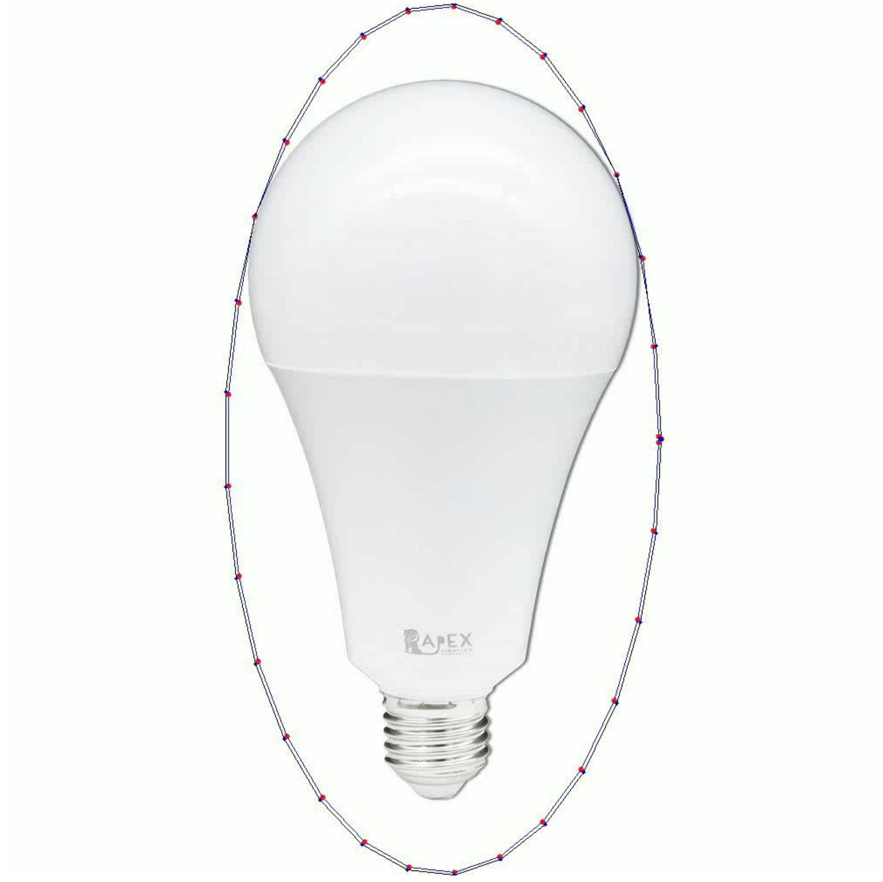
img2.jpg

img3.jpg

Example



result_img1.jpg



vid_img1.avi

Find The Contour

1. Read image
2. Convert RGB image to Grayscale
3. Do Gaussian Blur
4. Calculate the edge strength of image using Sobel operator
5. Generate *NUM_POINTS* points near the object
6. For i = 0 to *MAX_ITERATION*:
    a. points = *ACTIVE_CONTOUR()*
    b. Stop the loop if points are not changing
    c. Draw the new points on image
    d. Save current result
7. Save result video

```
ACTIVE_CONTOUR()
1. For each points:
    a. Set a search region
    b. For each pixel in search region ：
        a) Calculate $E_{cont}$ 、 $E_{curv}$ 、 $E_{img}$
        b) $E_{total} = \alpha E_{cont} + \beta E_{curv} + \gamma E_{img}$
        c) If $E_{total} < E_{min}$:
            ① Update $E_{min}$
            ② Update point position
2. Return points
```

$$\boxed{\begin{aligned} E_{cont} &= \|p_i - p_{i-1}\|^2 \\ E_{curv} &= \|p_{i-1} - 2p_i + p_{i+1}\|^2 \\ E_{image} &= -\|\nabla I\| \end{aligned}}$$

$$\|p_i - p_{i-1}\| = \sqrt{(x_i - x_{i-1})^2 + (y_i - y_{i-1})^2}$$

$$\|p_{i-1} - 2p_i - p_{i+1}\| = \sqrt{(x_{i-1} - 2x_i + x_{i+1})^2 + (y_{i-1} - 2y_i + y_{i+1})^2}$$

$$\|\Delta I\| = image\ gradient\ in\ that\ pixel$$

Rules in using OpenCV or other Lib

- ❑Allow use Opencv for C/C++
  - Read, load, save, show : cvLoadImage, cvShowImage …
  - Define size of image: cvSize, cvGetSize
  - Define image : Mat
- ❑Not Allow use
  - Cannot use the function of OpenCV Lib to do the main part of homework, only allowed to use if I said it/agree with it.
  - Not limited to the OpenCV library only
  - Example:
    - ✓ cvtColor(image, gray, CV_RGB2GRAY); // convert RGB to Gray
    - ✓ cv2.filter2D //directly use convolution
    - ✓ np.Convolve2D //directly use convolution

Grading

- Program (80%)
  - Set initial points (15%)
  - Find the contour (35%)
  - Save result videos (20%)
  - Coding Style (10%)
    - How many points and where to put for the initial step
    - How you built the function for find the contour
    - How you save the videos
- Report (20%)
  - Please explain your code for each part of question.
  - Please paste 3 output images in your report.
  - Please submit 3 videos images.

Folder Structure

Python

```
111999406 _hw4/
├── test_img/
│   ├── img1.jpg
│   ├── img2.jpg
│   ├── img3.jpg
├── result_img/
│   ├── result_img1.jpg
│   ├── result_ img2.jpg
│   ├── result_ img3.jpg
│   ├── vid_img1.avi
│   ├── vid _img2.avi
│   ├── vid_img3.avi
├── 111999406_hw4.py
├── 111999406_hw4.pdf
├── Readme.txt
```

C/C++

```
111999406 _hw4/
├── project_hw4/
│   ├── test_img/
│   │   ├── img1.jpg
│   │   ├── img2.jpg
│   │   ├── img3.jpg
│   ├── result_img/
│   │   ├── result_ img1.jpg
│   │   ├── result_ img2.jpg
│   │   ├── result_ img3.jpg
│   │   ├── vid_img1.avi
│   │   ├── vid_img2.avi
│   │   ├── vid_img3.avi
│   ├── include/
│   │   ├── func.h
│   ├── func.cpp
│   ├── main.cpp
├── 111999406 _hw4.pdf
├── Readme.txt
```

Write your report in **English (PDF)**

Explaining how your main function working and shown the results on your report.

Homework #4

- Please compress your files (program and report)
  - **StudentID_hw4(for example: 111999406_hw4.zip)**
  - **Make sure the size of .zip file is no more than 50MB**
- Please submit to iStudy, in Homework 4 Assignment.
- Deadline: **2024/01/02 23:59:59**
- For each hour late, 10% of the total score will be deducted.
- Don’t share your code with other students. Do it by yourself.

Thanks for your attention