2110431 Introduction to Digital Imaging

2147329 Digital Image Processing and Vision Systems

Homework #3

Deadline: November 21, 2023 @23:59

Submissions: (1) PDF version of this file ONLY problem 1 and 3 will be graded.

Submissions: (1) PDF version of this file

(2) .ipynb file; template in this link

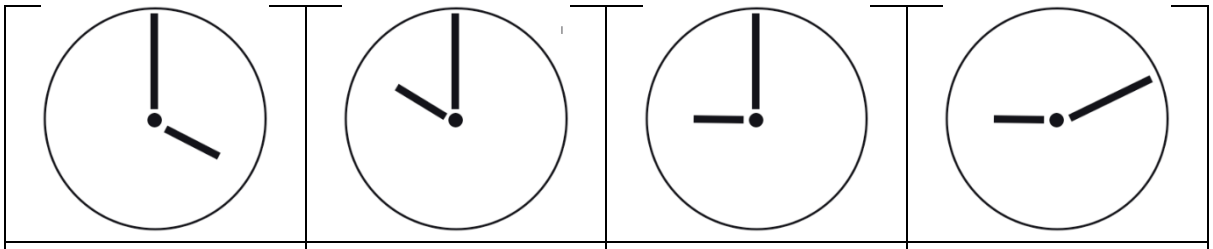
All images are in the hw3 folder.

IMPORTANT! (1) Before submitting the python file, please make sure it can be successfully compiled and correctly in its format name

(2) The scores will be 0 for all students whose source codes are very similar to each other.

1. (10 points) Reading a (very) simple clock

Use image processing to read a simple clock provided below and write a program using python library to provide output in the format displayed "HH:MM", such as "04:00" for the most left clock, "10:00" for the second clock, and so on. (HH in the range [01,12], MM in [00,59])



04:00	10:00	09:00	09:10

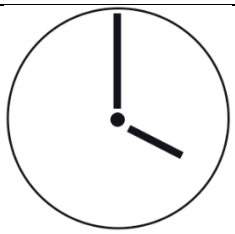
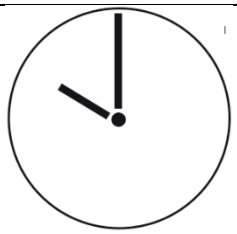
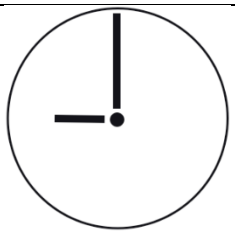
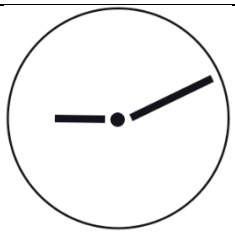
Note: your algorithm does not have to be 100% accurate; you should explain your results.

1.1) Describe steps of your algorithm

Steps	Description and purposes
1	Convert RGB image to Gray for processing the image
2	Make white Circle mask (radius = 140) for selecting the short hand and long hand
3	Make black Circle mask (radius = 10) for removing the clock center

4	Make threshold the image to convert to the binary image
5	Dilate the white area to make clock hand thinner for more accurately detecting line
6	Apply mask
7	Apply Canny for detecting edge
8	Use Hough line transform to find clock hand
9	If the edge of the clock hand has more than 1 line, combine the edge
10	Use the result from Hough line transform to get the coordinate of the clock hand corner for calculating the angle of the clock hand
11	Calculate the angle of the clock hand to get the hours and minutes
12	Display the output

1.2) Write down the results from your program:

			
4.00	10.00	9.00	9.10

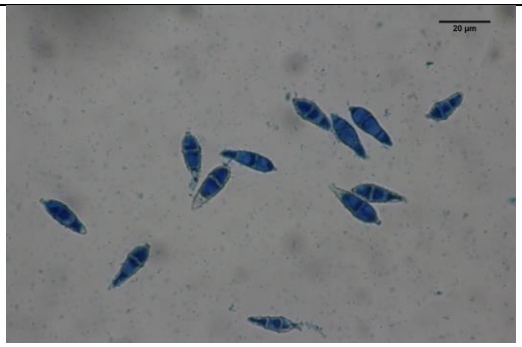
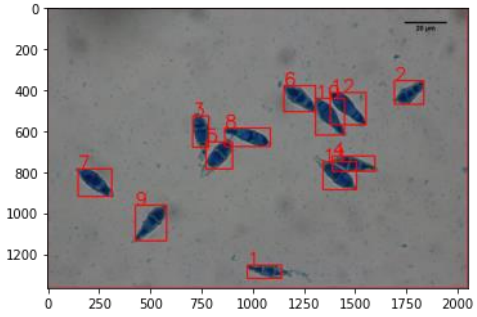
1.3) Analyze the results.

Hint: in terms of how accurate is your technique, any further improvement can be done?

My result is perfect accuracy so It can't improve in the accuracy term.

2. (Optional – for practice) Pyricularia Oryzae, rice blast fungus can cause rice blast disease. To identify the possibility of the occurrence of rice blast disease, the density of the spores of Pyricularia Oryzae can be calculated. Plant pathologist knows that you studied image processing, so they have asked you to help them automatically count the number of spores using image processing. They have provided two image samples below for you to develop an algorithm to count them. You should provide your results in terms of `num_count` and `resulted_image` (labeled count) (you can use cv2.rectangle(...) and cv2.putText(...) functions) as the example shown below

Note: your algorithm does not have to be 100% accurate; you should explain your results.

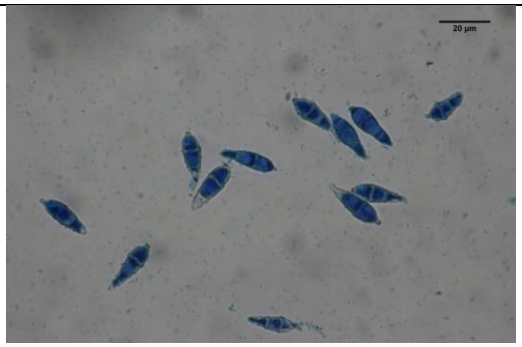
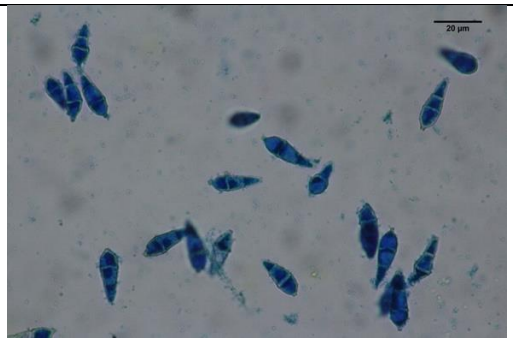
Original image	Your results / number of counted spores
 pyri02.png	EXAMPLE  num_count = 12

2.1) Describe steps of your algorithm

Steps	Description and purposes
1	
2	
3	

2.2) Results

Original image	Your results / number of counted spores

 pyri02.png	
 pyri02.png	

2.3) Analyze the results.

Hint: in terms of how accurate is your technique, any further improvement can be done?

3. (10 points) Separate and segment the oil in the beaker by distinguishing between solid (darker) and liquid oil. The container has a width and height, as shown in Figure 3.1. The equation for volume is $\pi r^2 h$, where r represents the radius and h is the height of the beaker, respectively.

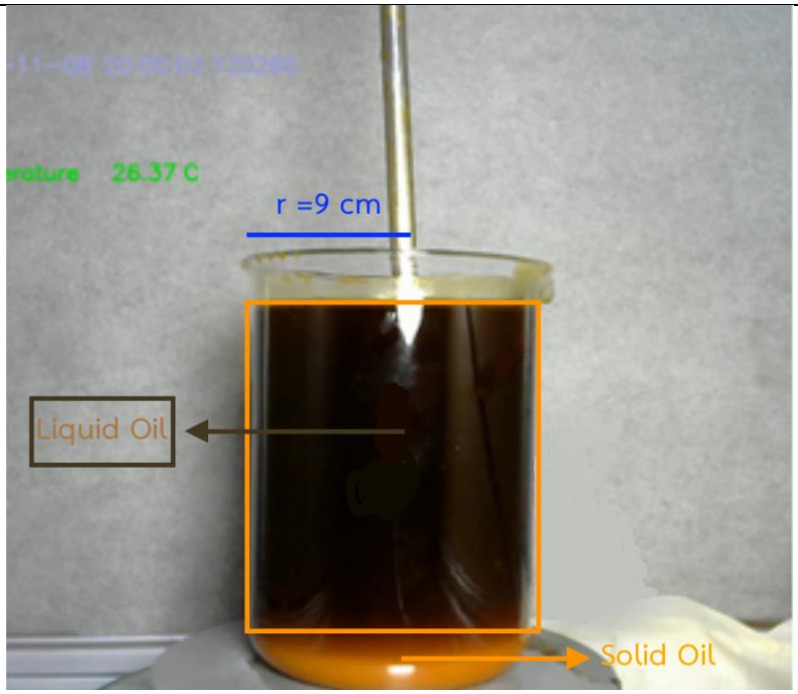
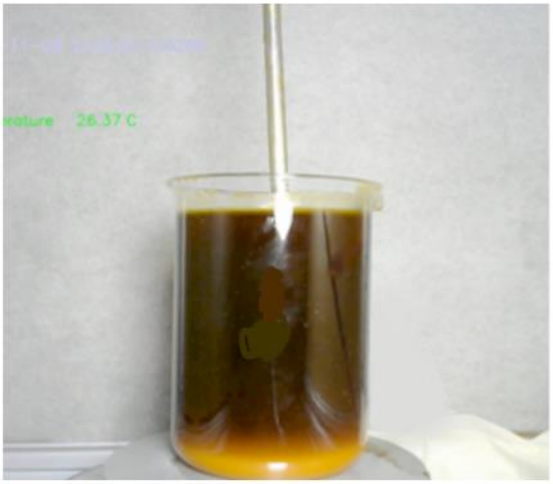


Fig 3.1 Crude oil (Oil.png)

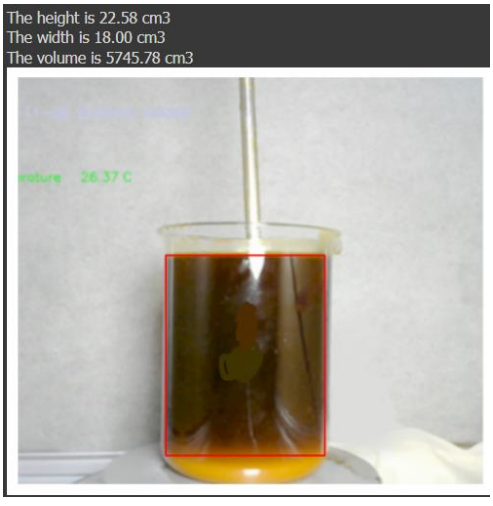
3.1 Find the volume of the oil in the liquid state.

Please use image enhancement, such as, Log transform, Power Law before apply segmentation. Then, you can use Otsu's, Adaptive Thresholding, Region Growing, and Manual Threshold to find the volume. Put your image results in the blank areas below.

Optional Enhancement image



Enhanced image



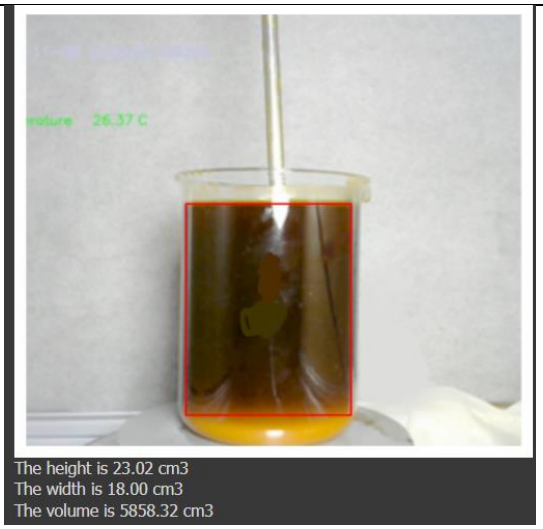
Segmented regions of the liquid oil and show width and height of the segmented image

Explain your steps and techniques used briefly:

1. Enhanced the image using gamma to make more different between liquid oil and solid oil
2. Use the manual threshold to segmentation the image
3. Use Contour to draw the rectangle to get width and height in pixel
4. Calculate the resolution (cm per pixel) reference to the width (18 cm) and then calculate the height the real height
5. Calculate volume and display the output

3.2 Segment the liquid oil again using Connected-component-with-stats method and compare the segmented result and calculated volume with 3.1.

Hint: Don't forget to use image Enhancement and connectivity either 4 or 8



Segmented region of the liquid oil using Connected Component with stats method.

Explain your steps and techniques used briefly:

1. Prepare the image by convert to gray image, make threshold
2. Use connectedComponentsWithStats to get the connected component
3. Sort the stat to get the 2nd biggest component (the oil)
4. From the stat, get the height and width for calculating the volume
5. Calculate the resolution (cm per pixel) reference to the width (18 cm) and then calculate the height the real height
6. Calculate volume and display the output

Compare to the 3.1 (use manual threshold)

The result of 3.1 is very close to the result of 3.2. 3.2 is bigger than 3.1 only 112.54 cm3

Note: You will get full score if the calculated volume for both 3.1 and 3.2 are within 10% error from our reference volume.