**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])

|  |  |  |  |
| --- | --- | --- | --- |
| Icon  Description automatically generated | Icon  Description automatically generated | Icon  Description automatically generated | Icon  Description automatically generated |
| 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 | Image results! |
| 2 |  |
| 3 |  |
|  |  |
|  |  |

1.2) Write down the results from your program:

|  |  |  |  |
| --- | --- | --- | --- |
| Icon  Description automatically generated | Icon  Description automatically generated | Icon  Description automatically generated | Icon  Description automatically generated |
|  |  |  |  |

1.3) Analyze the results.

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

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** |
| A picture containing outdoor  Description automatically generated  pyri02.png | **EXAMPLE**  **A picture containing text, several  Description automatically generated**  **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** |
| A picture containing outdoor  Description automatically generated  pyri02.png |  |
| A picture containing outdoor, flying, nature  Description automatically generated  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 , where represents the radius and 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:

|  |
| --- |
|  |

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:

|  |
| --- |
|  |
|  |

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.