Computer Vision Exercises

Tutorial 2: Image Recognition

14th December 2017

General Information

The proposed tutorial requires knowledge of computer vision, with focus on the image recognition, including both image segmentation and categorization. To perform this tutorial, use the 'coin' image.

The main goal of this tutorial is to create a program that will count the number of coins in the image and will recognize their size in an attempt to quantify the money in the image.

There are several ways to solve the problem and there is no "perfect solution". Counting objects is a fairly common problem in image analysis. Often the segmentation is difficult, due to non-uniform illumination, shadows, blur, reflections etc. The problems here are that some objects are slightly overlapping under a non-uniform illumination, as you can see in the provided images.

Tutorial 2 for assessment: A solution for the proposed exercises and the respective report should be delivered until 4th January 2018.

Design a program for image recognition of circular objects

Create a script called "*image_recognition*" to call a function "*main_image_recognition.m*" that execute the functions outlined in "2. Algorithm". In the script, you should create the grey-scale image before running the function "*main_image_recognition.m*".

1. Inputs

- **a grey-scale image**

The filename of the input image will be given as an argument to your program. Document what command one should type to run your program.

- **type of noise**

Your program should ask to the user the type of noise to be added separately to the input image: salt-an-pepper or gaussian noise.

- **noise parameters**

Provide the required parameters to add noise to the image (e.g., variance, % occurrence)

2. **Algorithm:** develop functions to perform the following tasks for each image.
    - **Load the image**.
    - **Introduce noise** in the image. Describe and justify the type of introduced noise.
    - **Process the image**, when necessary, using pre-processing techniques, such as filtering methods, contrast equalization, normalization, among other techniques. **Describe and justify the applied techniques.** Complement the justification with information extracted from the image.
    - Suggest and use a sequence of functions that solves the task of **segmenting all of the coins in the image**. Include an explanation for every function saying why that particular function was needed.
    - Show the **final segmentation result** and present a critical analysis regarding this result.
    - Count the **total number of coins** in the image.
    - Show a **histogram showing the distribution of object sizes**. Either area or radius could be used as a size measure.
    - Use a supervised approach (KNN or SVM) to **classify the objects** in the images, i.e., to identify the type of coins in the image. If necessary, use more images for the training phase.
    - **Bonus:** implement an algorithm that count the total **amount of money**.
    - **Discuss the errors and limitations in your final method**.

3. Outputs:

- Segmented image with and without noise;
- SNR of the noisy image to verify the level of noise introduced;
- Pre-processed image;
- Histogram showing the distribution of object sizes;
- Number and type of coins available in the image;
- **Bonus:** amount of money.

Note: all the outputs in the image form should be provided with the title, and when necessary, the axis label. On the other hand, all numeric outputs should be provided in a user-friendly way (e.g., structure, table, among others).