Assignment 1

Group of two (up to 3) persons.
Submission in the Moodle of the:

I. *code file ready to work;*
II. *report of a single A4 page for comments (mentioning right on the top, all points that were implemented).*

In this assignment, you will delve into the world of computer vision and image processing by developing a kind of Coinoscope, a visual coin measurement machine. Your goal is to process a database of coin images, extract essential properties, identify the coins, and calculate the total amount of money based on the coins in each image. You are provided with a database of coin images, each containing one or more coins. The images may have variations in lighting, orientation, and background clutter. The coins may include different types, such as 1, 2, 5, 10, 20 and 50 cents and 1 or 2 euros.

Considering these requirements:

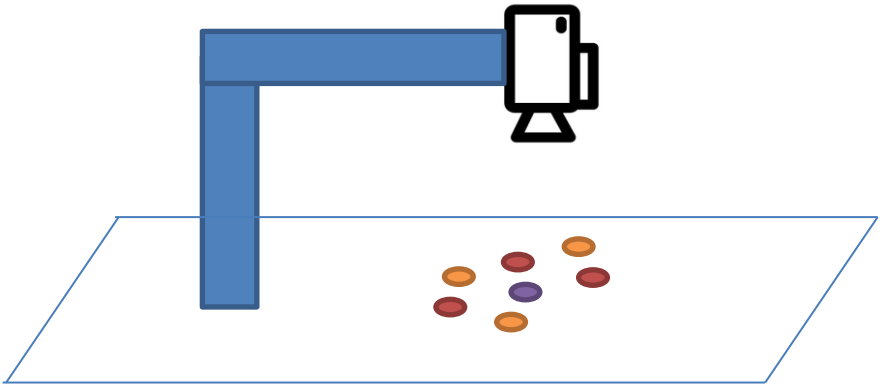

Figure 1 - setup of the imaging system.

a) Calibrate the intrinsic parameters and lens distortion of the camera.
b) Use the “External_calib_img” to calculate the conversion rate between pixel to millimeter. Discuss if the conversion rate obtained is uniform across the entire image.

c) Consider only the images retrieved from **single_coins**. Implement the functions described above.

I. Define a ROI (region of interest), automatically.
II. Coin Diameter Calculation: develop an algorithm to calculate the diameter of each coin in the images. Assume that the coins are perfectly circular.
    i. Provide the area of each coin in pixels and calculate the area of each coin in square millimeters. Make sure to clearly describe the method you use to approximate the coin's area.
    ii. Provide the diameter in millimeters for each coin.
    iii. Group by coin type and provide the mean and standard deviation for all coins of 1, 2 and 20 cents and 1 euro.
    iv. Show a histogram for *each type* of coin considering the hue-channel only. Use all images available in this folder.

d) Consider only the images retrieved from **multiple_coins**. Implement the functions described above.
    I. In images "*img_5_2_1cents*", "*img_50_20_10cents*" and "*img_50_20cents*" there may be multiple types of coins. Extend your identification algorithm to recognize and differentiate between various coin types within the same image. Provide the bounding box with a label for each coin detected and identified by your algorithm.
    II. Calculate the total amount of money in each image described above.
        i. Provide a histogram capturing the number of coins by the type of coins that is preset in the image.
        ii. Sum the values of the coins to find the total amount automatically.

e) Repeate the previous point to images "*img_coins_small*" and "*img_coins2_large*".

f) Consider the image "*img_coins_nbackground*" that depicts many coins captured without a white background. Repeat all the point d) without defining a region of interest.

g) Discussion: address the challenge of noise and complex backgrounds, including the properties of the hardware that was used for this Coinoscope and the presence of distracting elements that need to be filtered out to ensure accurate coin detection. Provide some suggestions to improve the performance of the Coinoscope (e.g., imaging setup, calibration process and photometric effects).