Zurich University
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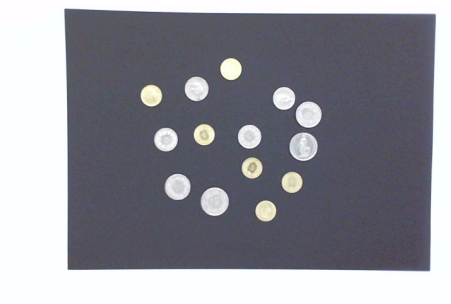
13-14 Mini Project - Coin Counter



Introduction

Welcome to the end of term mini project. You are going to use the knowledge acquired during the lectures, exercises and labs in order to implement a camera based coin counter with following mode of operation: Some coins are placed on the table and captured with a hand held USB camera connected to your computer. Using digital image processing, your program/script shall detect the coins, classify them (Classes: CHF 0.05, 0.10, 0.20, etc.) and count the total amount of money lying on the surface. The total amount should be displayed on the live image view, as well as the detected coins should be marked in some way, such that the user can visually check that all the coins have been detected.

1 The rules

- You are provided with a Logitec B525 webcam and a sheet of black paper in format A4. You are free to use your own camera if you want.
- You may work in groups, but please implement the program/script on every computer.
- You are free to use Python/OpenCV/Matlab
- You may use all available OpenCV functions such as e.g. cv2.HoughLines()
- Time slot: 2023-12-13 after the lecture (Lab), and 2023-12-20 08:00 to 12:00
- Optional submission: If you can show your working implementation until 2023-12-20 12:00, it will count as a bonus of 5 % on your final grade.

2 Simplifications

In this mini project, following requirements are defined to simplify the task:

- Due to reflections, coins are not always easy to handle in image processing. In order to facilitate the object detection, a black sheet of paper shall be used as the surface where the coins should lie.
- The black sheet of paper should be put onto the (bright) desk and the desk should be visible around the black paper. No objects or table borders should be visible around the black paper.
- The coins may touch each other, but they should not lie on top of each other.
- The angle of the camera should be approximately perpendicular to the surface.

3 Suggested Steps

a) Detect the corners of the black sheet of paper. Hints: Harris Corner and/or Hough Line Transform.

b) Use the detected corners and a projective transformation (homography) to undistort the sheet to a known surface (the A4 sheet is 297 x 210 mm). Hints: cv2.findHomography(), cv2.warpPerspective

c) Detect the coins. Hints: Thresholding, Distance Transform, Watershed Algorithm

d) Classify the coins according to their value and find the total value. Hint: The paper size is known. Coin diameters: `https://www.snb.ch/en/iabout/cash/id/cash_coins#t2`

e) Display the total value onto the original image.

f) Mark the detected coins on the original image. Hint: Inverse homography.

4 Possible Improvements

Here are some ideas how to improve the coin counter if you have time left:

- Implement warnings for measurements with low confidence.
- As there is only a limited number of possible diameters of coins, the use of the Circle Hough Transform can be appropriate. It even could help to detect coins lying on top of each other.
- Remove the restriction of using a sheet of paper. This means: a) No black background, b) no easy help for undistortion and c) find another way to determine the coin diameter (e.g. color of the 0.05, ratios of diameters, detect imprint of at least one coin, ...?).
- Allow other objects on the surface.
- Implement the program as an app on android and/or iOS.