U.PORTO
FEUP FACULDADE DE ENGENHARIA
UNIVERSIDADE DO PORTO

FEUP
M.EEC
COMPUTER VISION

2024/2025

Assignemnt 1

Sorting M&M chocolates

Group of two (up to three) persons.
Submission in the Moodle of the colaboratory developed:

1. *code file ready to work (the import of dataset must be automatically performed. Save the colab after running all cells of the program);*

2. *report for commenting all points implemented.*

The sorting center of a M&M factory retrieves visual data from the production line to determine the type of chocolates produced. The factory uses a computer vision application to automatically calculate some properties of the sample, namely:

- the distribution of each color in the sample, e.g., the number of red (or blue or ...) chocolates. At the end, if the sample does not have chocolate of all colors, the system must raise an alarm by printing "Color XPTO is missing";

- identify the **type** of peanuts in the line, namely **with** or **without peanut**;

- the average shape area of all chocolates in millimeters and organized by color.
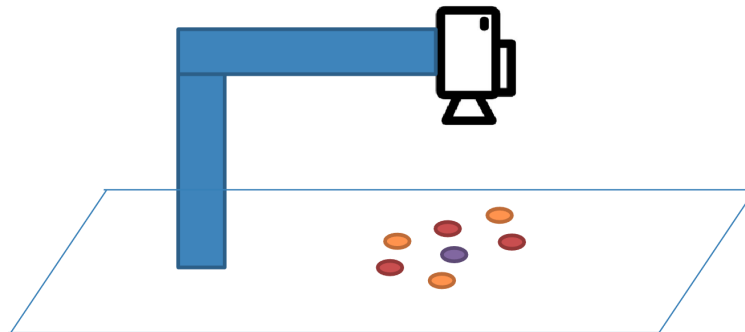

Figure 1: Setup of the imaging system.

Considering these requirements:

1. Calibrate the intrinsic parameters and lens distortion of the camera. Show the intrinsic matrix, the lens distortion coefficients and the re-projection error.

2. Calibrate the extrinsic parameters of the camera setup (or instead, use the extrinsic image to manually measure the dimensions of a black square of the chessboard in pixels. In this way, you will know the conversion between pixel to millimeter). Show the extrinsic matrix (rotation, translation, etc) and/or the conversion ratio between pixel to millimeter that was used.

3. Consider only the images with the **isolated** M&Ms retrieved from a **white background**. Implement the functions described below.

   (a) Define a ROI (region of interest) for the image;

   (b) Show a histogram for each image of M&Ms considering HSV;

   (c) Determine the average area for the M&Ms in pixels. Show the M&Ms detections;

   (d) Determine the **average** area and **standard deviation** for each M&Ms type (with or without peanut) and color in millimeters. Show the result in a table type vs color vs area and standard deviation.

4. Consider only the images with the **mixed** M&Ms retrieved from a **white background**. Implement the functions described below.

   (a) Calculate the number of M&M per color and type for all images provided;

   (b) Show the M&Ms detections and centroids;

   (c) Provide the table capturing the number of M&Ms type (with or without peanut) and color that are present in each image;

   (d) Discuss the limitation of the method implemented (in 2 sentences);

   (e) Provide some recommendations that the M&M factory should take into consideration to improve the performance of the sorting process based on image processing (e.g., imaging setup, calibration process and photometric effects), in 4 sentences.

5. (3 points) Consider the images retrieved from a **brown background** and repeat the previous points (4a, 4b, 4c).

Notes:

- **white_isolated** - folder with isolated M&Ms images retrieved from a white background;

- **white_mix** - folder with mixed M&Ms images retrieved from a white background;

- **brown_mix** - folder with mixed M&Ms images retrieved from a brown background;

- **(color)_nut.png** - images containing peanuts inside **white_isolated**;

- **(color).png** - images without peanuts inside **white_isolated**;