Assignment 1

Group of two (up to 3) persons.

Submission in the Moodle of the colaboratory developed:

I. *code file ready to work (the import of dataset must be automatically performed. Save the colab after running all cells of the program);*
II. *report for commenting all points implemented.*

The quality assurance tester of a M&M factory retrieves a sample from the production every hour to determine some properties of chocolate peanuts. 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 peanuts of all colors, the system must raise an alarm by printing "Color *XPTO* is missing".
- the average shape area of all chocolate peanuts in millimeters and organized by color.

Considering these requirements:

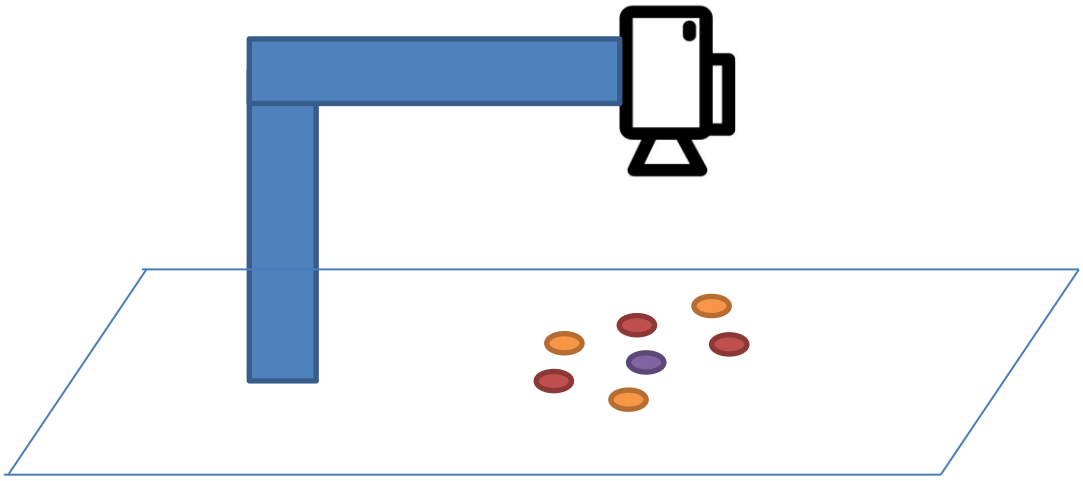

Figure 1 - setup of the imaging system.

a) Calibrate the intrinsic parameters and lens distortion of the camera. *Show the intrinsic matrix and the lens distortion coefficients.*

b) 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*.

c) Consider only the images retrieved from a **White Background**. Implement the functions described above.
   I. Define a ROI (region of interest) for the image;
   II. Calculate the number of M&M per color for all images provided;
   III. Determine the **average area** for peanuts in pixels, considering the image "*calib_img 3*";
      i. Show all peanuts that were detected.
      ii. Discuss the limitations of the peanut detection method used (in 2 sentences).
   IV. Determine the **average area** (and **standard deviation**) for peanuts in millimeters and grouped by color, considering images "*calib_img 2*" and "*calib_img 3*".
      i. Show the result in a table color vs area and standard deviation.
      ii. Discuss the limitation of the method implemented (in 2 sentences).
   V. Provide some recommendations that the M&M factory should take into consideration to improve the performance of the quality assurance process based on image processing (e.g., imaging setup, calibration process and photometric effects), in 4 sentences.

d) (*5 points*) Consider the images retrieved from a **Grey Background** and repeat the previous point without defining a region of interest.