INSTITUTO SUPERIOR DE ENGENHARIA DE LISBOA
MESTRADO EM ENGENHARIA INFORMÁTICA E DE COMPUTADORES
MESTRADO EM ENGENHARIA INFORMÁTICA E MULTIMÉDIA
IMAGE PROCESSING AND BIOMETRICS

Laboratory Project 2 - 1st semester, 2021/2022 (January, 3)
Due Date (Code and Report): February, 14

Submit the code along with the report containing the experimental results, as well as the corresponding analysis and comments, into the Moodle system.

1. Consider the digital image processing applications **CodeCardGenerator** and **CAPTCHA**, from Laboratory Project 1.
   (a) Search online by an *Optical Character Recognition* (OCR) software tool, `https://en.wikipedia.org/wiki/Optical_character_recognition`, developed on any programming language at your choice. Test the software and check its proper functioning, on some images at your choice. Report on the experimental results.
   (b) Consider the grayscale and color images generated with the **CodeCardGenerator** and **CAPTCHA** applications. Apply the chosen OCR software to these images. Comment on the results regarding the obtained text extraction quality. Identify in which situations and conditions in the input image, the OCR software:
      . extracts the text with no errors;
      . extracts the text with some errors;
      . fails to extract (e.g. ignores) the existing text.

2. The `Medical-Images.zip` file contains a set of grayscale medical images.
   (a) For each image on this file, chose an adequate and specific pseudo-coloring technique suitable to highlight the details of the image, for human visualization and interpretation. State the technique that you chose to apply for each image.
   (b) Report the obtained experimental results for each image. Comment on the quality of the results.

3. The *Synthetic Fingerprint Generator* (SFinge) software, developed by the Biometric System Laboratory, University of Bologna, Italy, generates synthetic fingerprint images. The software is available at `http://biolab.csr.unibo.it/ResearchPages/SFinGe_Download.asp`. Some examples of images generated by the software are available on this address `http://biolab.csr.unibo.it/ResearchPages/SFinGe_Samples.asp`.
   (a) Install and test SFinge. Generate ten different images with the software (five with *capacitive* background and five with *optical* background).
   (b) Devise and develop a minutiae detection method for these fingerprint images. The output of the method should be a binarized version of the image with the minutiae placed/marked on the images, as depicted in Figure 1.
   (c) Devise and develop a fingerprint recognition (for identification and authentication) method based on the minutiae detection method. Report the experimental results of the method. Comment on these results.

Figure 1: The SFinge software and an example of the minutiae detection algorithm: input image and output image with minutiae identification.

4. Develop a digital image processing application for face image handling. The input face image is provided by a graphics file or from the PC Webcam. The application should handle color images and to provide the following features:

   (i) Identity hiding - The output is a face image such that it has a blocky pattern hiding the face (and the identity) of the person, but allowing to see that there is a person on the image.

   (ii) Face detection and crop - The output is a cropped image containing only the face pixels.

   (iii) Visible Watermark - The output image has a (always) visible watermark placed at the bottom of the image, as depicted in Figure 2, `https://en.wikipedia.org/wiki/Digital_watermarking`

   (iv) Visual “Filter" - Adds some visual effect over the face image, such as a hat, a mask or other objects, as depicted in Figure 2.

   For each of the four features:

   (a) Explain, in detail, the procedure/algorithm that you follow to implement each feature.

   (b) Report experimental results using some images from the `Face-Images.zip` file and the PC Webcam.

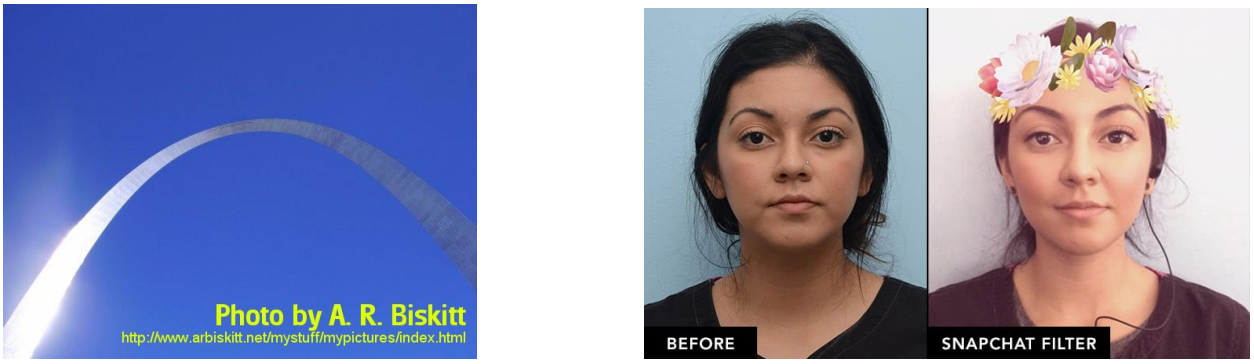

Figure 2: Example of visible watermarking (left) and visual “filter” (right).
`https://en.wikipedia.org/wiki/Digital_watermarking#/media/File:Watermark_example.jpg`
`https://www.yourfaceinourhands.com/blog/we-took-a-snapchat-challenge`