

FACE DETECTION CHALLENGE

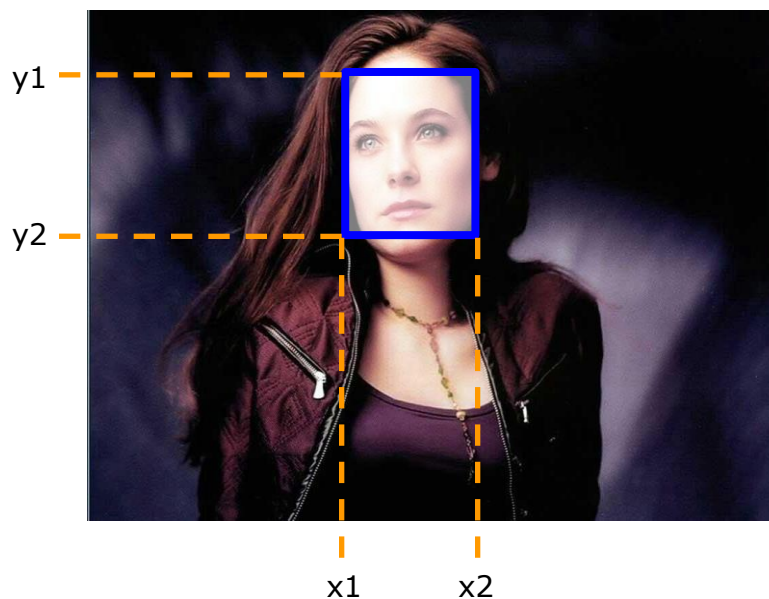
Project Description

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1. Introduction

The objective of this group project is producing an automatic face detection system that works in MATLAB or Python and achieves the specified performance on a test set of 600 facial images (these images will NOT be provided with the challenge material).

Given an input image, the automatic system is expected to return the bounding box of all faces present in the image or an empty array otherwise (i.e. if there are no faces). Bounding boxes will be specified by their top-left and bottom-right coordinates, specified in pixels and concatenated in a single row. For example, in the image below, the detection would be $[x1, y1, x2, y2]$:



Multiple detections will be arranged in multiple rows (one row per detected face). For example, if 3 faces (a, b and c) are detected the output would be:

$$\begin{bmatrix} x1a & y1a & x2a & y2a \\ x1b & y1b & x2b & y2b \\ x1c & y1c & x2c & y2c \end{bmatrix}$$

Team work

This project must be carried out in teams. Each team will have 2 or 3 members. Each team member is expected to understand all the work that the team performs, so that he/she would be able to answer any question about the presented work if requested by the teacher(s). Failure to meet this requirement will result in a sanction that will be applied equally to all team members.

Materials

There will be two different datasets for this project: 1) the Training Dataset; 2) the Test Dataset.

- The Training Dataset is composed by 600 images that will be provided to the students for their own development and evaluation of the detection system. The performance obtained in this dataset is expected to serve as indicative performance to students themselves, but will not be taken into account for the actual evaluation of the system.
- The Test Dataset is composed by 600 images that differ from the images in the Training Dataset but were obtained from the same source and following a similar procedure. Therefore, system performance on the Test Database is expected to be similar to -but not exactly the same as- the performance on the Training Database. The Test Database will be used to calculate the final performance of the detection system for the purpose of evaluation. This database will not be made available to students before the challenge is over.

2. Performance specifications

The automatic face detection system must fulfill the following performance metrics (when evaluated in the Test Database):

- Accuracy: Modified F1-score average ≥ 0.80
- Speed: Average processing time ≤ 1.5 seconds per image
- Implementation: Must execute in Matlab or Python with no errors or exceptions

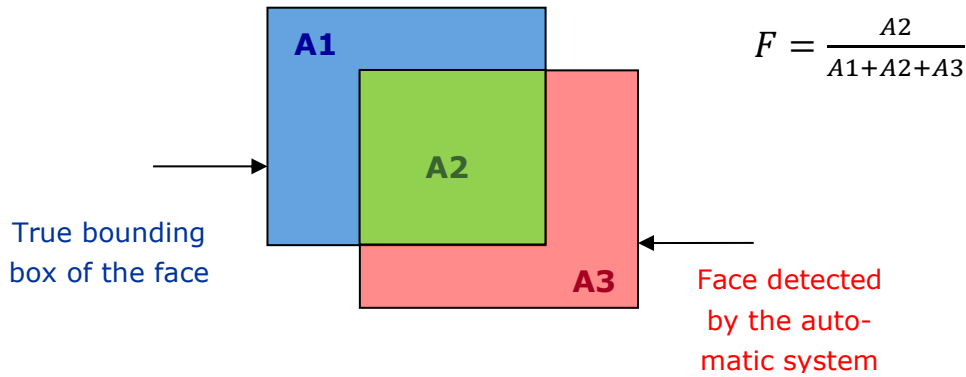
An input face must be detected whenever it is possible to identify its mouth, nose and both eyes or eyebrows (sun glasses will count as eyes). For example, in a full-profile face we can only see one eye/eyebrow but not the other; therefore this face will not be taken into account.

Accuracy

Accuracy will be measured in terms of a modified F1-score, which is defined as follows:

$$F = \frac{TruePositives}{TruePositives + FalseNegatives + FalsePositives}$$

In the context of bounding box detection, the above can be interpreted as the area of intersection of true and detected bounding boxes divided by their union, as illustrated below:



Therefore, for each face in the Test Database an F-score between 0 (complete failure) and 1 (perfect detection) will be computed. The average over all faces in the Test Database must be above 80/100.

Speed

The evaluation of the detection system on the whole Test Database cannot take more than 15 minutes. Therefore, the average processing time must not exceed 15 minutes / 600 images, i.e. 1.5 seconds per image.

Implementation

Since students will not have access to the Test Database, the detection system will be evaluated by the teachers. Therefore, the following must be fulfilled:

- The system must run in MATLAB/Python, accepting an image as the only input and returning a matrix with as many rows as faces were detected and 4 columns with the bounding box coordinates as explained in Page 2.
- For the current edition of the Detection Challenge, if there are more than 2 faces in a given image, only the 2 biggest ones will be considered.
- Any external source will need to be appropriately referenced with clear indications for any required installation for the detection system to run.

3. Project submission

For a project to be complete, each team must submit the following material strictly before the deadline (16-Jan-2024, 23:59 CET):

- The detection system (MATLAB/Python code, fulfilling the instructions from the previous page)

Only one submission per team will be accepted (e.g. there will be no preliminary evaluation on the Test Database). Teams are advised to ensure their performance results on the

Training Database are sufficiently above the minimum requirements to guarantee a successful evaluation.

The project will be marked considering that it fulfills the minimum requirements, higher performance will be awarded higher marks. If minimum requirements are not met, the project will be marked 'F' regardless of the other elements in the list.

Remember that this lab will be jointly evaluated with Eigenfaces lab.