U.PORTO
FEUP FACULDADE DE ENGENHARIA UNIVERSIDADE DO PORTO

MASTER IN INFORMATICS AND COMPUTING ENGINEERING | 4TH YEAR
M.EIC029 | COMPUTER VISION | 2021/2022

PROJECT – PART 1

Traffic sign detection and classification

Summary

Automatic recognition of traffic signs is important for driver assistance systems, automated driving and inventory purposes. The recognition process is usually composed of two main steps: detection of sign candidate regions and identification of signs. Traffic signs are usually classified into several classes: prohibitory, mandatory, yield, warning and information. The main objective of this project is to develop a program for the automatic detection of a subset of the signs used in Portugal (see annex) and the classification of the detected sign into a set of classes, according to the combination of sign color and shape.

General aims

To apply the theoretical knowledge about Image Processing and Analysis acquired in the Computer Vision course, namely, segmentation techniques, based on color and shape information, using the OpenCV library as development tool.

Specific aims

In Portugal, as well as in other countries, traffic signs have a large variety in terms of color and shape. The purpose of this project is not to recognize the signs but just detect a subset of the existing signs and classify the detected sign(s) into one of 3 classes.

The main goals are (basic version - 85% of the grade):

1) detect and classify signs that belong to one of the following 3 classes (see some examples in Figure 1), taking into account the sign color and shape:
   - stop sign;
   - red circles;
   - blue squares/rectangles.
2) evaluate the performance of the classification task (e.g. accuracy), considering a reference dataset [Road Sign Detection - https://www.kaggle.com/datasets/andrewmvd/road-sign-detection], excluding the "traffic light" class of the dataset; note: other images can be added to the evaluation dataset.

a) b) c) d) e) f) g)

Figure 1 – Examples of traffic signs from the 4 classes: a) stop; red circles; b-d) red circles; e-g) blue squares/rectangles.

Assumptions – in order to simplify the problem, you may assume that (some examples in Figure 2):

- the optical axis of the camera is almost perpendicular to the sign plane;
- the signs are well illuminated (they are not in shadow);
- there is no partial occlusion of the signs;
- there is only one traffic sign in the image.

Figure 2 – Possible situations to be dealt with in the basic version.

Possible improvements (15% of the grade):

- remove one or more of the above referred simplifying assumptions, for example, to deal with: more than one traffic sign in the same image, triangular signs, circular blue signs, poorly illuminated signs, slanted signs – some examples in Figure 3.

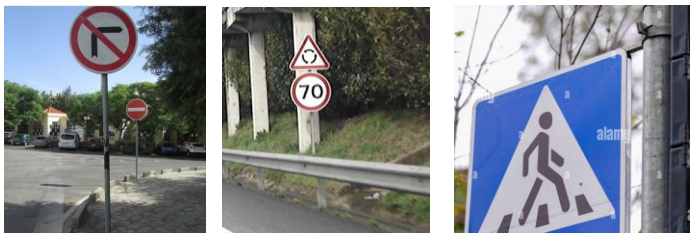

Figure 3 – Possible situations to be dealt with in the improved version.

Project development, report and delivery

The work must be done by groups of 3 students.

A short report (max. 3 pages) must be delivered, including:

- any additional specifications (if needed);
- the description of the proposed global solution, including illustrations of the results of the main intermediate steps;
- relevant comments about the efficacy of the used methods, describing the main problems that were encountered and any proposed solutions;
- the status of the proposed method and the degree of fulfillment of the aims;
- an analysis of performance of the proposed method, illustrated with some results.

The report should use the template available in Moodle. Annexes may be included to show additional results that do not fit in the main report.

The code, with meaningful comments and processing examples, must be submitted in Jupyter notebook format.

The work must be submitted at the Computer Vision page in Moodle, until the end of April 30, 2022.

A final presentation, including both parts of the project, will be done by the end of the semester.

Bibliography and Images

- M. García-Garrido, M. Sotelo, E. Martín-Gorostiza, "Fast Traffic Sign Detection and Recognition Under Changing Lighting Conditions", Proceedings of the 2006 IEEE Intelligent Transportation Systems Conference,Toronto, Canada, September 17-20, pp. 811-81, 2006
- A. Ruta, F. Porikli, S. Watanabe, Y. Li, "In-vehicle camera traffic sign detection and recognition". Machine Vision and Applications, 22, pp. 359-375, 2011
- A. Møgelmose, M. Trivedi, T.Moeslund, "Traffic sign detection and analysis - Recent studies and emerging trends", 15th International IEEE Conference on Intelligent Transportation Systems, pp. 1310-1314, 2012
- S. Wali, M.Abdullah, M. Hannan, A. Hussain, S. Samad, P. Ker, M. Jern, M. Mansor, "Vision-Based Traffic Sign Detection and Recognition Systems: Current Trends and Challenges". Sensors. 19. 2093, 2019
- "Traffic signs", https://traffic-rules.com/en/portugal/traffic-signs/information
- "Portugal Road Signs", https://www.autoeurope.com/travel-guides/portugal/portugal-road-signs/
- "A Sinalização Rodoviária", https://www.invicta.pt/codigo/sinalizacao.asp (*in portuguese*)
- Road Sign Detection: https://www.kaggle.com/datasets/andrewmvd/road-sign-detection (2022-03-22)

ANNEX – Portuguese traffic signs