Traffic Sign Detection

COMPUTER VISION - PROJECT 1 - MIEIC - 13/14
CARLOS MIGUEL CORREIA DA COSTA - 200903044 - CARLOS.COSTA@FE.UP.PT

1. Applications



Fig. 1.1 - Driver assistance systems



Fig 1.2 - Autonomous vehicles

2. Implementation main algorithms

- ✓ Scene acquisition (image, video, camera)
- 1. Image preprocessing
- 2. Signal color segmentation
- 3. Text color segmentation
- 4. Traffic sign recognition

2.1. Image preprocessing

a) Bilateral filtering

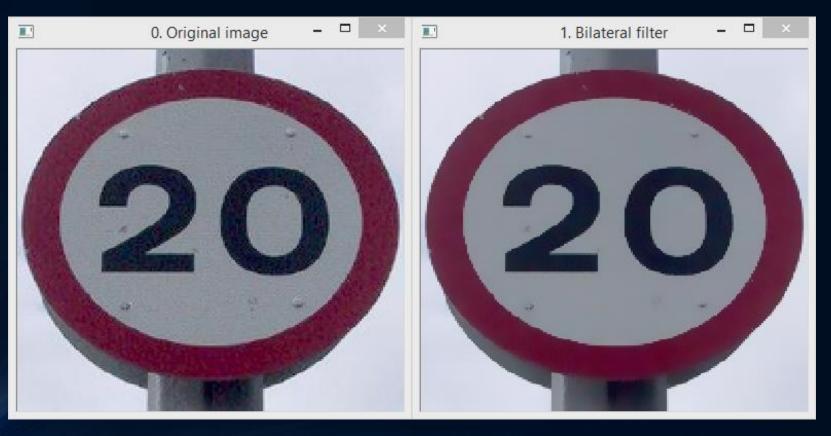


Fig. 2.1a — Effect of the bilateral filter in removing noise

2.1. Image preprocessing

b) Contrast limited adaptive histogram equalization (CLAHE)



Fig. 2.1b – Effect of the CLAHE in increasing contrast

2.1. Image preprocessing

c) Contrast and brightness correction



Fig. 2.1c – Correction of contrast and removal of noise

2.2. Signal color segmentation

- a) Signal segmentation in HSV color space using the red borders
- b) Usage of opening morphological operation to remove small blobs

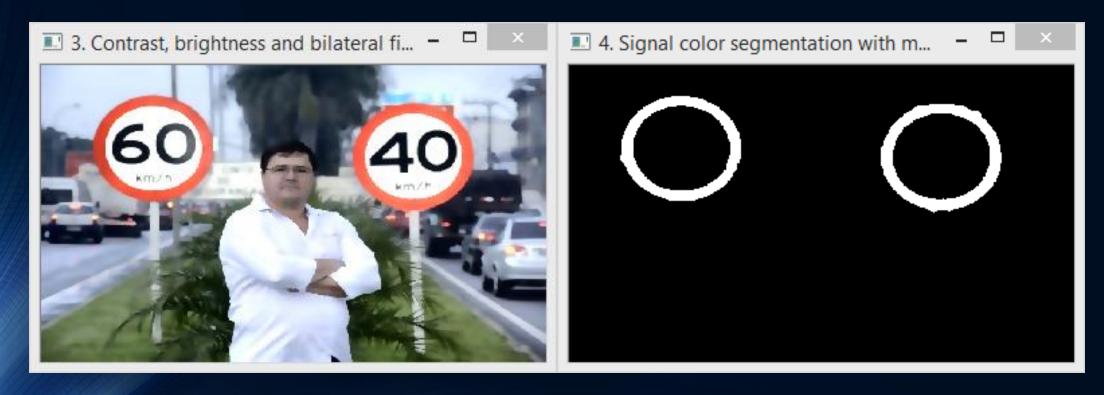


Fig. 2.2a – Identification of possible traffic sign positions using color segmentation

2.2. Signal color segmentation

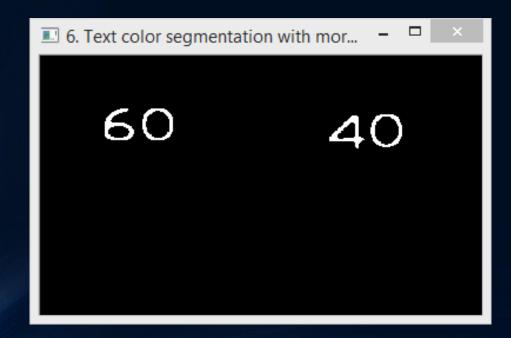
- c) Identification of signals circles using HoughCircles transform
- d) Detection of signals borders with OpenCV fitEllipse



Fig. 2.2b – Usage of HoughCircles transform and ellipse extraction to segment the signals from the image

2.3. Text color segmentation

- a) Extraction of each signal from the image, removing the background
- b) Segment text only inside signs ellipsis
- c) Usage of erosion operation to thin the text and improve recognition



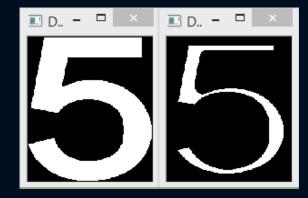


Fig. 2.3b – Application of the erosion operator

Fig. 2.3a — Text extraction using color segmentation

 a) Application of template matching or feature detection to identify the numbers inside the traffic signs ellipsis

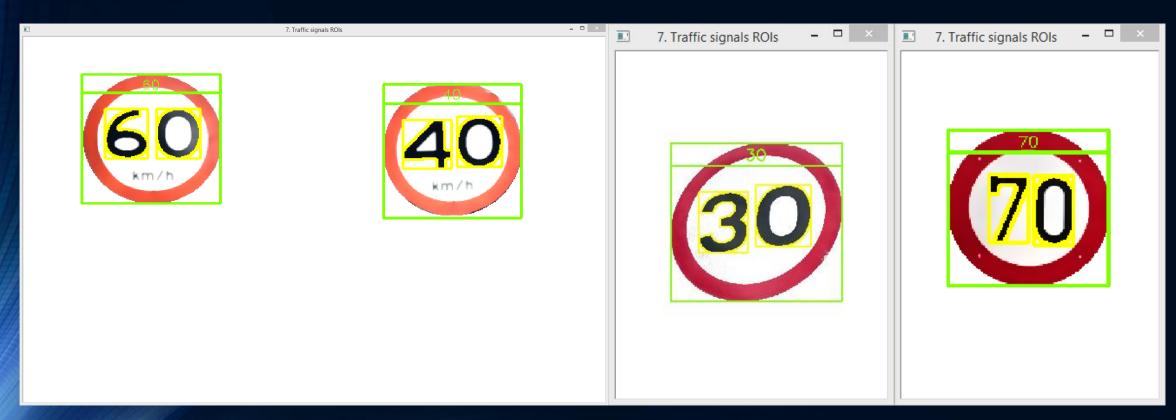


Fig. 2.4a — Number recognition using GoodFeaturesToTrackDetector, SiftDescriptorExtractor and FlannBasedMatcher

 a) Feature detection results for signals with good segmentation and positioning



Fig. 2.4b – Good matches between feature points

a) Feature detection results for signals with good segmentation and some perspective distortion

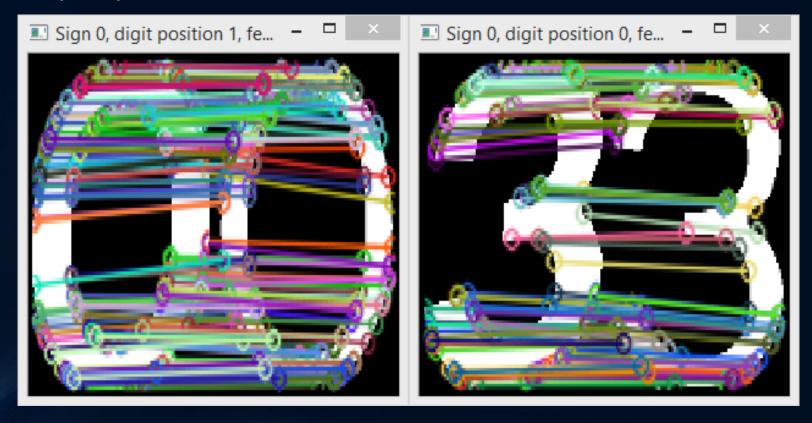


Fig. 2.4c – Good matches between feature points

a) Feature detection results for signals with suboptimal segmentation (on purpose), and how the feature points adapted

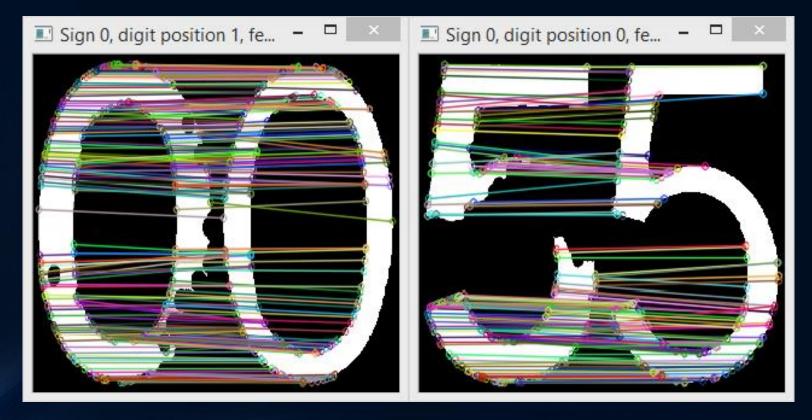


Fig. 2.4d – Good matches between feature points

3.1. Parameterization

a) The HighGUI interface for main algorithms parameterization

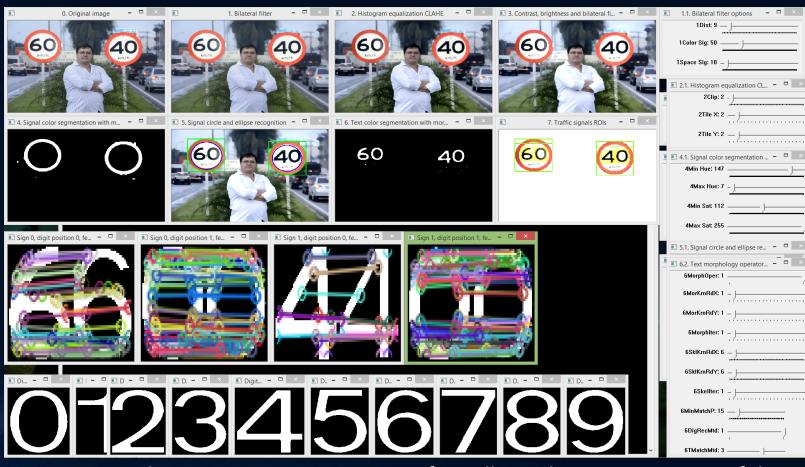


Fig. 3a – HighGUI parameterization interface allows the customization of the algorithms parameters to obtain better results

3.2. Parameterization

a) Default parameterization used

| ■ 1.1. Bilateral filter options – □ × | ■ 4.1. Signal color segmentation □ × | | ■ 6.2. Text morphology operator |
|---|---------------------------------------|--|---------------------------------|
| 1Dist: 9 | 4Min Hue: 147 | 5Hough DP: 1 | 6MorphOper: 0 |
| 1Color Sig: 50 | 4Max Hue: 7 | 5MinDCntr%: 2 | 6MorKrnRdX: 1 |
| 19nace Sig. 10 | 4Min Sat: 112 | 5CnyHiThrs: 200 | |
| 1Space Sig: 10 | 4Max Sat: 255 | 5AccumThrs: 25 | 6MorKrnRdY: 1 – |
| 2.1. Histogram equalization CL X | 4Min Val: 32 | 5MinRadiu%: 1 | 6Morphiter: 3 |
| 2Clip: 2 | 4Max Val: 255 | 5MaxRadiu%: 100 | 6SklKrnRdX: 6 |
| 2Tile X: 2 — | ■ 4.2. Signal morphology operat – □ × | ■ 6.1. Text color segmentation o – □ × | 6SklKrnRdY: 6 — |
| 2Tile Y: 2 | 4MorphOper: 0 | 6Min Hue: 20 | parameter |
| ■ 3.1. Contrast and brightness op – □ × | 4MorKrnRdX: 2 | 6Max Hue: 140 | 6Skellter: 2 |
| 3Contr*10: 11 | 4MorKrnRdY: 2 | 6Min Sat: 0 | 6MinMatchP: 33 |
| 3Brigh*10: 25 | 4Morphiter: 1 | 6Max Sat: 255 | 6DigRecMtd: 1 |
| | | 6Min Val: 0 | 6TMatchMtd: 3 |
| | | 6Max Val: 147 | |

Fig. 3b – Parameterization to recognize normal speed limit signs

Questions?