Using Fourier Descriptors and Spatial Models for Traffic Sign Recognition

Linköping University

Fredrik Larsson and Michael Felsberg
Computer Vision Laboratory, Linköping University, Sweden

Abstract

Traffic sign recognition is important for the development of driver assistance systems and fully autonomous vehicles. We propose to use locally segmented contours combined with an implicit star-shaped object model as prototypes for the different sign classes. The contours are matched efficiently by using a correlation based matching scheme for Fourier descriptors. We demonstrated on a publicly available database state of the art performance.

Contributions:

The main contributions of this paper are:
1) Extending the work in [1] with an implicit star-shaped object model, leading to improved performance.
2) Removing the need for a region-of-interests detector used in [1] leading to a fully automatic system.
3) Releasing a database with more than 4000 hand labeled frames containing a total of 3488 traffic signs.

Method:

1. Extract all contours c(l) from the query image

$$c(l) = c(l + L) = x(l) + iy(l),$$

2. Represent each contour as a Fourier descriptor (FD)

$$C(n) = \frac{1}{L}\int_{l=0}^{L} c(l)\exp(-\frac{i2\pi nl}{L})\,dl \quad n = 0, ..., N,$$

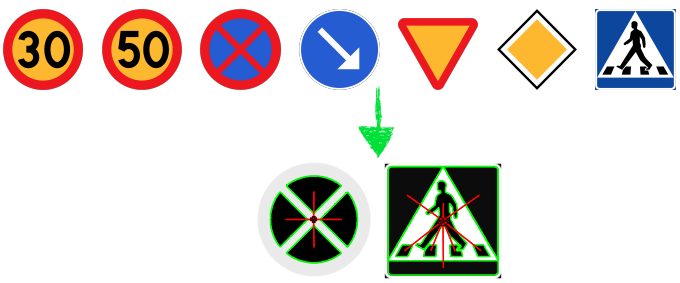
3. Match all query FDs ($\mathbf{Q}_j$) against the individual FDs ($\mathbf{C}_k$) for each prototype

$$e_{jk} = 2 - 2\max_{l}\mathrm{Re}\{\mathcal{F}^{-1}\{\bar{\mathbf{Q}}_j \cdot \mathbf{C}_k\}(l)\}$$

4. Report a match for FDs that matches the individual contours of a prototype and also adheres to the spatial requirements.

Prototypes:

Prototypes are created from synthetic icons of the different sign types.

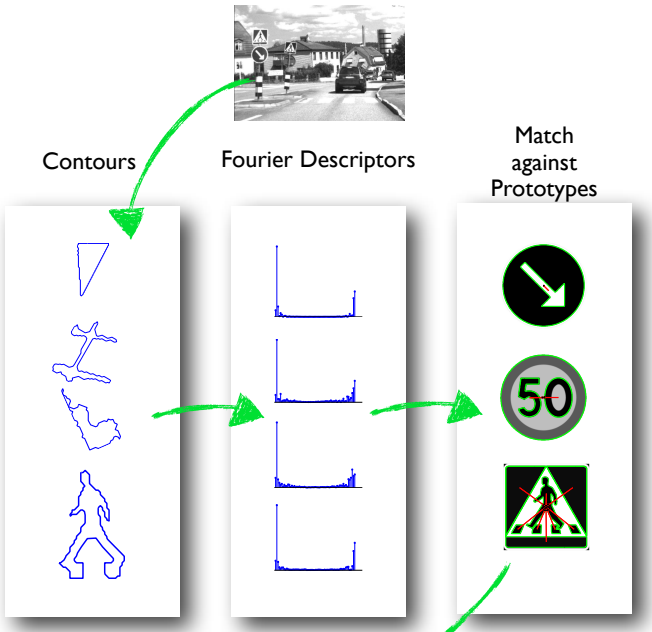


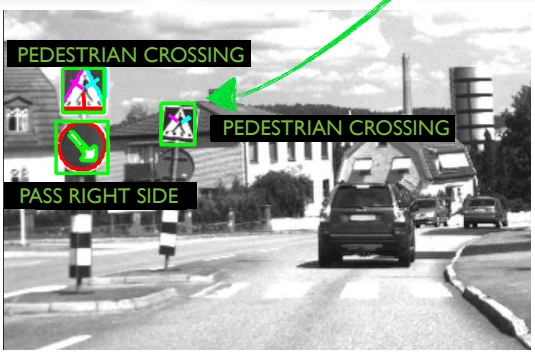
Datasets:

Manually ROIs: 216 patches around signs

Summer dataset: 20 000 frames, 20% labeled, full images

www.cvl.isy.liu.se/research/traffic-signs-dataset/





	Proposed method		[1]	
Sign type	Recall	#FP	Recall	#FP
Pedestrian crossing	98.0	0	98.0	1
Designated lane right	95.8	0	95.8	2
No standing or parking	100.0	0	96.6	1
50 kph	91.7	2	91.7	2
30 kph	95.8	1	95.8	1
Priority road	95.7	0	95.7	1
Give way	94.7	0	94.7	2

TABLE I
Performance on the ROI dataset

Sign type	Precision	Recall
Pedestrian crossing	96.03	91.77
Designated lane right	100.00	95.33
No standing or parking	97.14	77.27
50 kph	100.0	76.12
Priority road	98.66	74.24
Give way	59.26	47.76

TABLE II
Performance of the proposed method on the new dataset

Acknowledgement

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[1] F. Larsson, M. Felsberg and P.-E. Forssén, "Correlating Fourier Descriptors of Local Patches for Road Sign Recognition," IET Computer Vision, 2011, Accepted for publication

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