A classification architecture based on connected components for text detection in unconstrained environments

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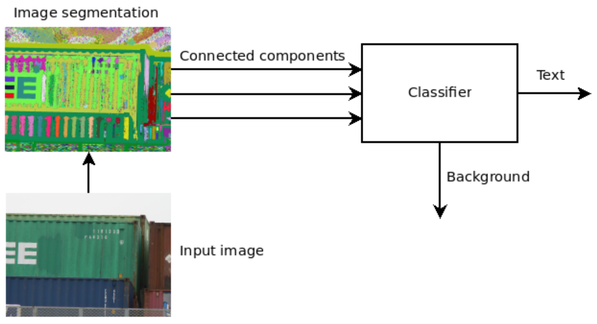
The paper presents a method for efficient text detection in unconstrained environments, based on image features derived from connected components and on a classification architecture implementing a focus of attention approach. The main application motivating the work is container code detection with the final goal of checking freight trains composition. Although the method is strongly influenced by the application experimental evidence speaks in favour of its generality: we present results on container codes, car plates images, and on the benchmark dataset ICDAR 2003.

The proposed system architecture



Objectives and user requirements

• The main focus is **container code detection** to the purpose of monitoring the entrance of freight trains in stations.

→ There is no prior information neither on the amount of clutter in the scene, not on the container appearance (it may change in color, size, amount of dirt)

→ There is some knowledge on the characters font.

→ Major requirement: keep computational cost low – this is just one module of a complex monitoring system.

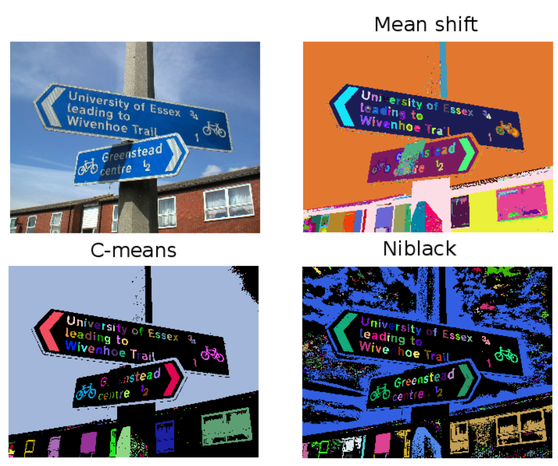
Image segmentation

$$\text{NiBlack(x, y)=} \begin{cases} 1 & f(x,y) > T_+(x,y) \\ -1 & f(x,y) < T_-(x,y) \\ 0 & otherwise \end{cases}$$

$$T_\pm(x,y) = \mu(x,y,W_m) \pm k\sigma(x,y,W_s)$$

• Integral images allow us to segment one image (NXM) in one visit only. Complexity is O(NM)

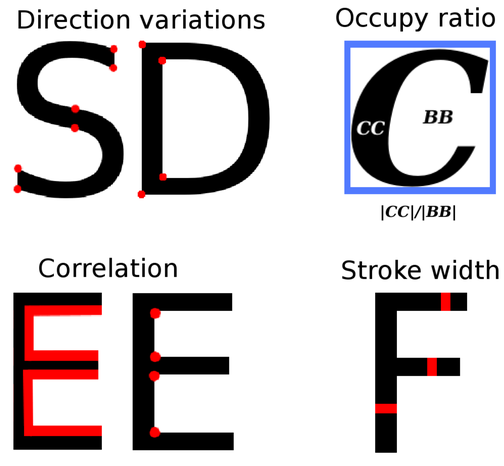
• The method (Niblack, 1985), thanks to its local approach, is less sensitive to non-uniform illumination than other state of the art methods



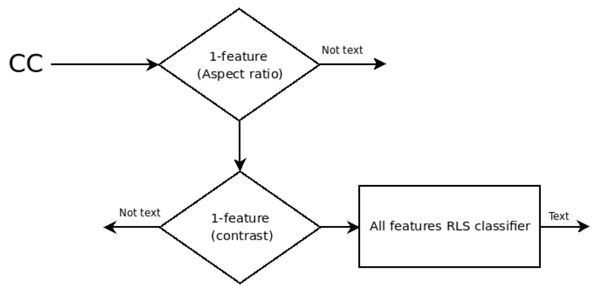
Connected components (CC) descriptors from the literature

Feature	Reference (see paper)
Aspect ratio	Zhu *et al* (2007)
Occupy ratio	Zhu *et al* (2007)
Edge contrast	Zhu *et al* (2007)
Edge Symmetry	Lucas *et al* (2005)
Run length	Chan *et al* (2001)
Contour roughness	Zhu *et al* (2007)
Contour roughness (variant)	Zhu *et al* (2007)
CC Holes	Zhu *et al* (2007)
Perimeter length	Zhang *et al* (2004)
Zernike moments	Zhang *et al* (2004)
Generalized Fourier Descriptor	Zhang *et al* (2004)
Normalized central moments	Zhang *et al* (2004)
Hu moments	Zhang *et al* (2004)

Ad hoc CC descriptors



The classification architecture



The dataset

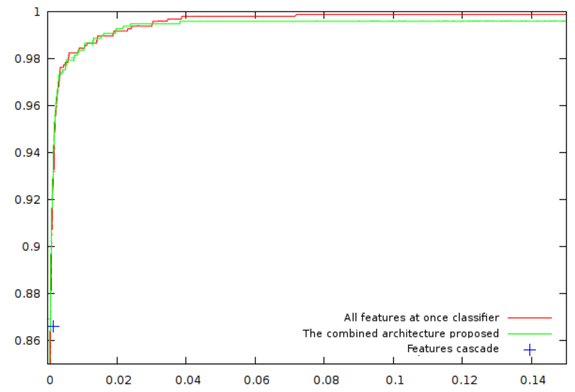
• ∼ 100 segmented container code images produced:

→ 500 CC characters and 500 CC negative shapes used as a training set

→ 970 CC characters and 40000 CC negative shapes used as a test set

• About 120 data from license plate images were used to further performance evaluation

Classification results



The proposed architecture achieves similar performance to a one-layer classifier but is about **four times faster**.

Text detection experiments

Results on previously unseen container images acquired under different weather conditions

Results on images from the ICDAR 2003 dataset.

Conclusions

• We proposed a text detection method to be applied as a container code detection within a monitoring system for freight trains [a].

• The method is rather general and achieved very good results, not only on container code images (eer below 2%), but also on car plates images (eer=1.2%). Images from the ICDAR 2003 db have also been processed with success.

• The computational cost of the proposed method is low in accordance to user requirements (about 15 fps on the whole frame, 25 fps if applying prior information on the approximate code position).

• An analysis on the weaknesses of the method lead us to conclude that most errors are due to the segmentation phase. Future work will be devoted to strengthen the image segmentation phase.

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http://slipguru.disi.unige.it