Approach for Document Detection by Contours and Contrasts

smart engines™ MIPT Federal research centre Computer Science & Control Russian Academy of Sciences IITP RAS

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1. Document detection problem

Input: Image.
Output: Quadrilateral corresponding to the document location.
Assumptions: (1) one document in the image, (2) all document borders are visible, (3) document has an unknown internal structure, (4) **possible complex background**, (5) no camera intrinsic parameters.

Fig 1. Image with complex background from MIDV-500

2. Existing appoaches

Contour-based: use contour score to rank quadrilaterals -> unstable on the complex background (red quadrilateral on Fig.1) **Region-based**: use region (contrast) score to rank quadrilaterals -> works well even with the complex background (green quadrilateral on Fig. 1)

3. The ranking problem

Input: (1) Image $\boldsymbol{I}$, (2) set of $\boldsymbol{N}$ quads, (3) ground truth quad $\boldsymbol{m}$.
It is required to define a function $\boldsymbol{F}$ such that

$$\begin{cases} i^* = \arg\max_{i=0}^{N} F(q_i, I) \\ L(q_{i^*}, m) = 1 \end{cases},$$

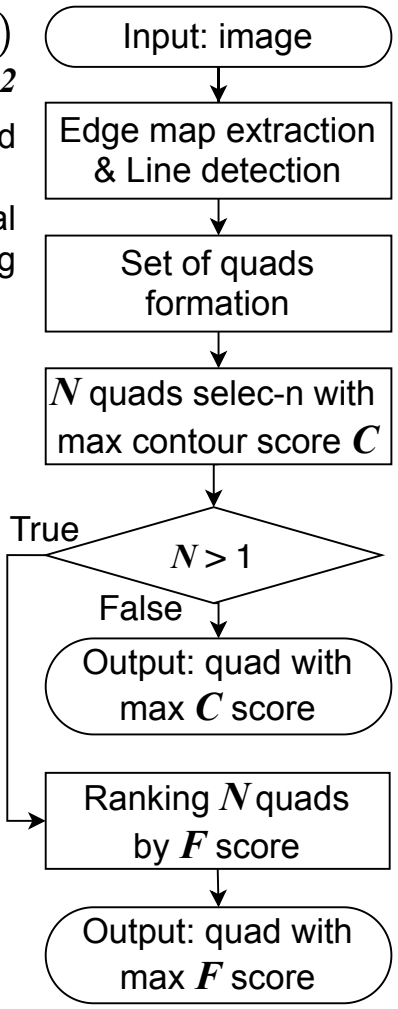
where $\boldsymbol{L}$ is a binary quality metric.

4. Proposed function $\boldsymbol{F}$

$$F(q, I) = R(q, I) + kC(q, I)$$

Region score is based on χ^2 distance between foreground and background sets of RGB pixels.
Contour score is based on integral statistics of edge map along borders of $\boldsymbol{q}$.
$\boldsymbol{k}$ is a combination coefficient.

5. Proposed algo



6. Error classification on MIDV-500

	Out of frame	No line	Ranking error	Total errors	Run-time (ms/frame)
Prop. algo. (N=1)	2850	660	854	4366	82
Prop. algo. (N=11)	2803	627	509	3941	88
Relative improvement	+1.65%	+5%	**+40.4%**	+9.73%	-7.3%

Table 1. MIDV-500 is open dataset with 15 000 images of ID cards; Detection is incorrect (error) if Jaccard Index < 0.945; Run-time measure on iPhone 6 in single thread mode

7. Comparison with top 2 system on SmartDoc

System	MIDV-500 Full	SmartDoc					
		Bgr 1	Bgr 2	Bgr 3	Bgr 4	Bgr 5	Full
Prop. algo. (N=1)	0.861	0.980	0.974	0.982	0.966	0.294	0.906
Prop. algo. (N=11)	**0.870**	0.983	0.974	0.983	0.970	0.319	0.910
CS-NUST-2	0.626	**0.988**	**0.976**	**0.984**	**0.974**	**0.948**	**0.978**

Table 2. Mean Jaccard Index

ICPR 2020
25th INTERNATIONAL CONFERENCE ON PATTERN RECOGNITION
Milan, Italy 10 | 15 January 2021