Historical Handwritten Text Images Word Spotting through Sliding Window HOG Features

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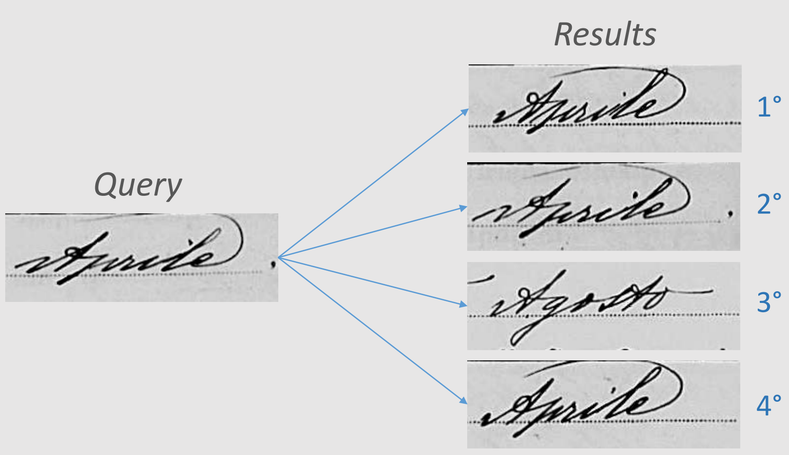
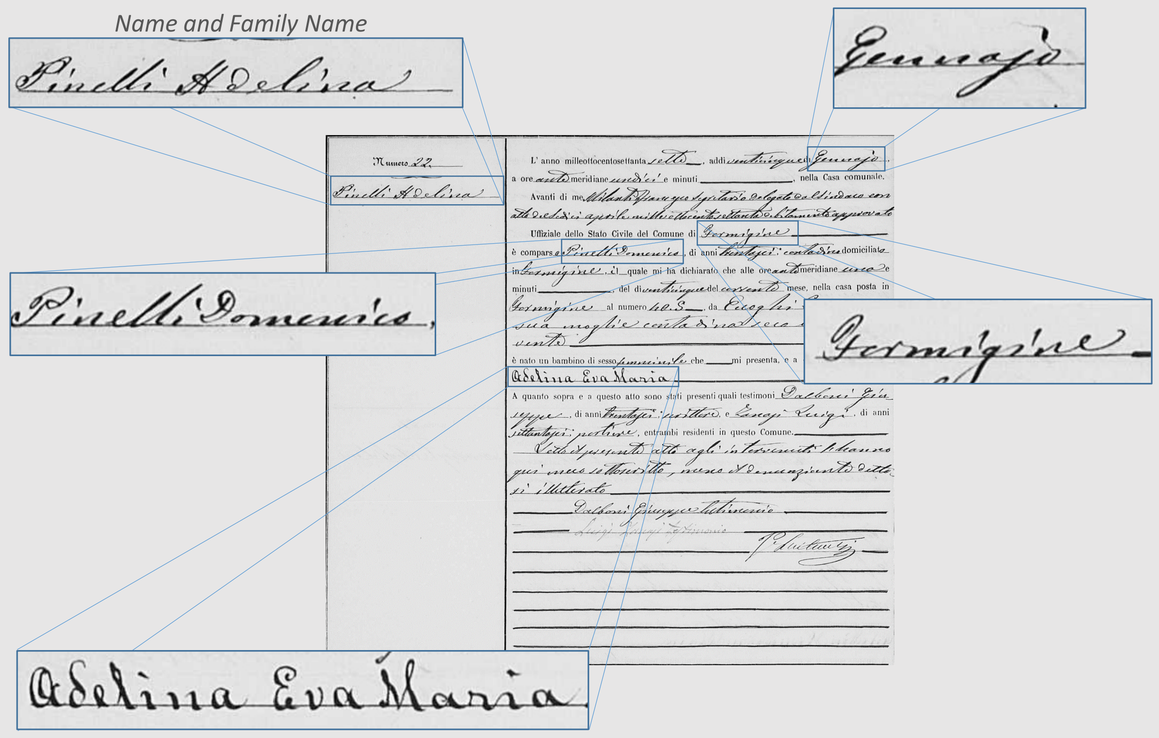
Problem Statement

The project, named XDOCS, aims at extending to a much wider audience the possibility to access a variety of historical documents published on the web. In this context, we develop a new word spotting technique able to extract document indexes in quasi-automatic mode from their handwritten contents. The devised solution is based on HOG descriptors and exploits *Dynamic Time Warping* technique to compare feature vectors elaborated from single handwritten words.

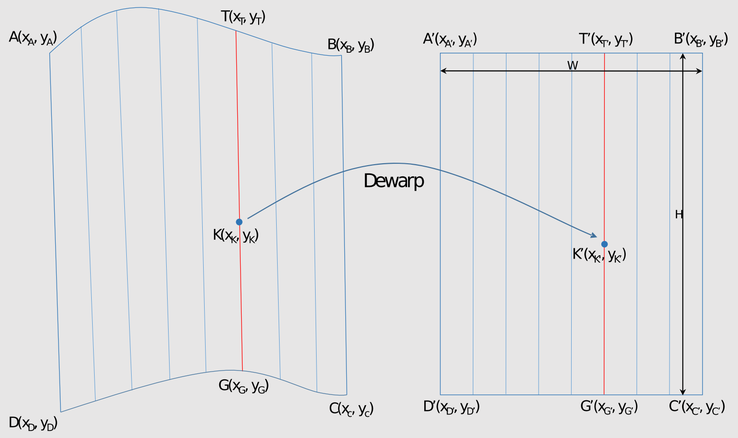


Intended Indexes and New Challenging Dataset



Indexing Pipeline

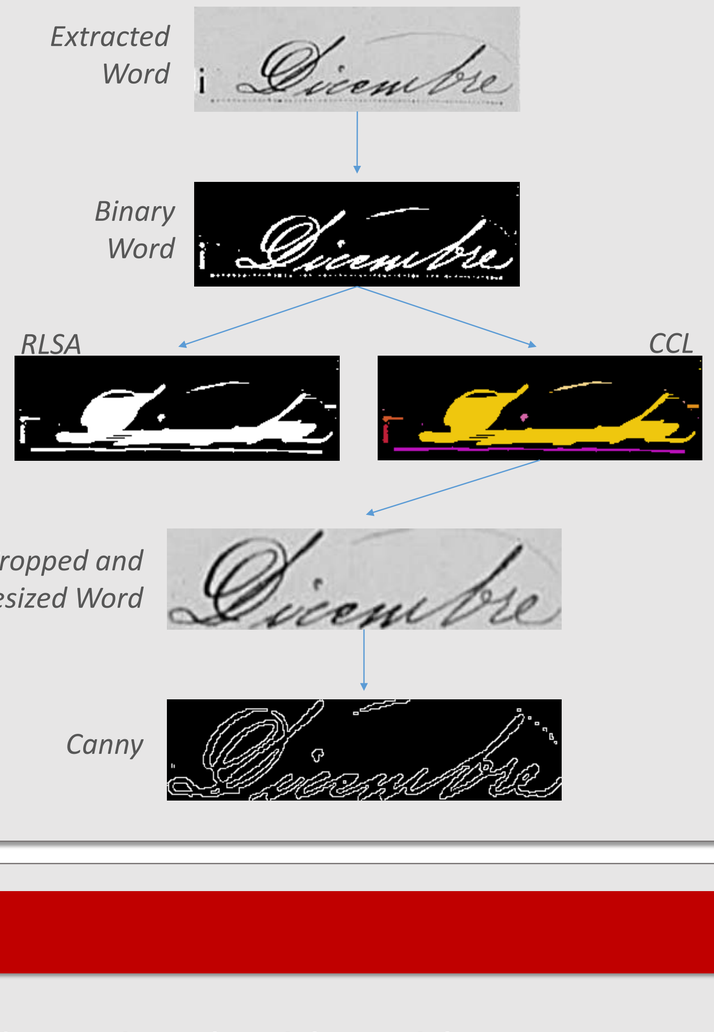
① Image Dewarping



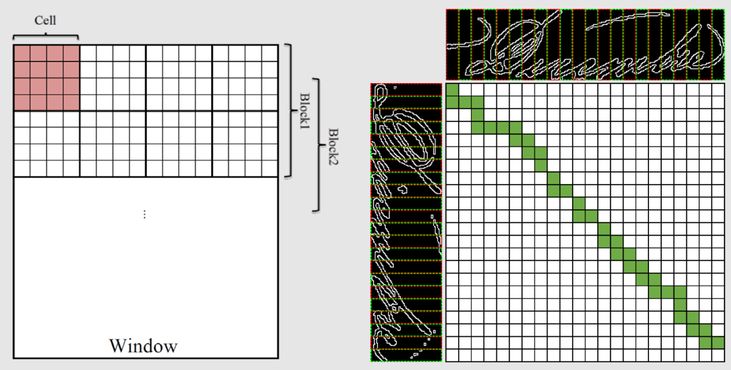
Aims at mapping the projection of the curved surface, represented by four polynomial lines, to 2D rectangular area with fixed dimensions.

$$\begin{cases} x'_k = x'_A + W * \dfrac{|\widehat{AT}|}{|\widehat{AB}|} \\ y'_k = y'_A + H * \dfrac{|TK|}{|TG|} \end{cases}$$

② Word Extraction and Preprocessing



③ Word Matching Based on HOG Descriptor and Dynamic Time Warping



$$DTW(i,j) = min\begin{cases} DTW(i-1,j) \\ DTW(i,j) \\ DTW(i,j-1) \end{cases} + \sum_{k=1}^{N} |x_{ik} - y_{jk}|$$

Experimental Results

***Intra* and *Inter* dataset evaluation of word spotting algorithm with:**

- *Mean Averages Precision* (MAP) with *cut-off* at C = {5, 10, 15}:

$$MAP@n = \frac{\sum_{i=1}^{Q} ap@n_i}{N} \qquad ap@n = \frac{\sum_{k=1}^{n} P(k)}{\min(m,n)}$$

- Correct Match First (CMF): percentage of queries with P(1) = 1.

Check out the project website

xdocs

		Vignola	*Carpi*	*Formig.*
Vignola	MAP@05	0.528	0.1	0.181
	MAP@10	0.38	0.086	0.144
	MAP@15	0.306	0.093	0.132
	CMF	75.25%	17.82%	26.73%
Carpi	MAP@05	0.135	0.466	0.095
	MAP@10	0.101	0.434	0.078
	MAP@15	0.079	0.414	0.072
	CMF	14.53%	63.25%	15.38%
Formig.	MAP@05	0.192	0.127	0.644
	MAP@10	0.156	0.114	0.541
	MAP@15	0.135	0.121	0.476
	CMF	24.69%	19.25%	77.82%

Results with 16 pixels stride

		Vignola	*Carpi*	*Formig.*
Vignola	MAP@05	0.634	0.108	0.206
	MAP@10	0.465	0.098	0.168
	MAP@15	0.376	0.101	0.156
	CMF	83.17%	18.32%	25.25%
Carpi	MAP@05	0.145	0.534	0.112
	MAP@10	0.11	0.489	0.093
	MAP@15	0.086	0.485	0.086
	CMF	17.10%	66.67%	17.95%
Formig.	MAP@05	0.268	0.15	0.775
	MAP@10	0.209	0.133	0.662
	MAP@15	0.173	0.138	0.582
	CMF	36.82%	21.34%	89.96%

Results with 8 pixels stride

		Vignola	*Carpi*	*Formig.*
Vignola	MAP@05	0.665	0.102	0.222
	MAP@10	0.493	0.093	0.189
	MAP@15	0.4	0.098	0.17
	CMF	87.13%	14.85%	27.22%
Carpi	MAP@05	0.159	0.578	0.125
	MAP@10	0.117	0.536	0.101
	MAP@15	0.091	0.527	0.096
	CMF	19.66%	73.50%	17.95%
Formig.	MAP@05	0.309	0.177	0.823
	MAP@10	0.235	0.152	0.708
	MAP@15	0.194	0.153	0.621
	CMF	40.59%	26.77%	94.14%

Results with 2 pixels stride

		Vignola	*Carpi*	*Formig.*
Vignola	MAP@05	0.468	0.042	0.077
	MAP@10	0.347	0.034	0.057
	MAP@15	0.276	0.028	0.05
	CMF	68.32%	9.90%	13.37%
Carpi	MAP@05	0.086	0.445	0.087
	MAP@10	0.06	0.411	0.067
	MAP@15	0.05	0.382	0.058
	CMF	13.78%	51.70%	15.34%
Formig.	MAP@05	0.097	0.053	0.557
	MAP@10	0.071	0.045	0.413
	MAP@15	0.06	0.042	0.342
	CMF	19.25%	9.21%	80.33%

Competitors (Rath et al.)