

Contents

Part I Introduction

1 Introduction	3
1.1 Document Image Analysis and Recognition Context	3
1.1.1 Accessibility to Large Document Collections	4
1.1.2 Information Spotting	5
1.2 Symbol Spotting	6
1.3 Outline of this Book	9
1.4 Organization	11
References	13
2 State-of-the-Art in Symbol Spotting	15
2.1 Introduction	15
2.2 Spotting Graphical Elements	15
2.2.1 Word Spotting	16
2.2.2 Symbol Spotting	18
2.3 Symbol Description	19
2.3.1 Photometric Description	21
2.3.2 Geometric Description	23
2.3.3 Syntactic and Structural Description	29
2.4 Descriptors Organization and Access	32
2.4.1 Sequential Access	33
2.4.2 Hierarchical Organization	34
2.4.3 Prototype-Based Search	35
2.4.4 Hashing Approaches	36
2.4.5 Spatial Access Methods	37
2.4.6 Curse of Dimensionality	39
2.5 Hypotheses Validation	39
2.5.1 Statistical Validation	40
2.5.2 Voting Strategies and Alignment	40
2.6 Conclusions and Discussion	41
References	42

Part II On the Use of Photometric Descriptors for Symbol Spotting

3	Symbol Spotting for Document Categorization	51
3.1	Introduction and Related Work	51
3.2	Outline of the Approach	53
3.3	Document Categorization by Logo Detection	53
3.3.1	Feature Extraction and Description	54
3.3.2	Logo Representation and Matching	56
3.3.3	Bag-of-Visual-Words	57
3.4	Introducing Spatial Density for Logo Spotting	58
3.5	Experiments	59
3.5.1	Evaluation Methodology	60
3.5.2	Performance Comparison	60
3.6	Conclusions and Discussion	62
	References	64

Part III On the Use of Geometric and Structural Constraints for Symbol Spotting

4	Vectorial Signatures for Symbol Recognition and Spotting	69
4.1	Introduction and Related Work	69
4.2	Pre-processing Step: Raster-to-Vector Conversion	71
4.2.1	Document Binarization	72
4.2.2	Skeletonization	73
4.2.3	Polygonal Approximation	74
4.3	A Vectorial Signature for Symbol Description	75
4.3.1	Representing Symbols by Attributed Graphs	75
4.3.2	Building the Vectorial Signature	77
4.4	Sequential Access to Signatures: Defining Regions of Interest	79
4.5	Experimental Results	80
4.6	Conclusions and Discussion	85
4.6.1	Limitations of the Vectorial Signatures	87
	References	88
5	Symbol Spotting Through Prototype-based Search	89
5.1	Introduction and Related Work	89
5.2	String Matching Theory and Algorithms	92
5.2.1	Definitions	92
5.2.2	Linear String Matching	93
5.2.3	Cyclic String Matching	94
5.2.4	A String Matching Cost Function for Polygon Recognition	95
5.3	Spotting Method	96
5.3.1	Symbol Representation in Terms of String Primitives	96
5.3.2	Off-line Lookup Table Construction	98
5.3.3	On-line Querying of Symbols: Activating Table Entries	99

5.3.4	Hough-Like Voting Scheme to Validate Location Hypotheses	100
5.4	Experimental Results	102
5.4.1	Silhouette Shape Matching	102
5.4.2	Evaluation of the Contours as Primitives	104
5.4.3	Symbol Spotting in a Document Database	106
5.5	Conclusions and Discussion	108
	References	110
6	A Relational Indexing Method for Symbol Spotting	113
6.1	Introduction and Related Work	113
6.2	Description of Graphical Symbols in Terms of Vectorial Primitives	114
6.2.1	Vectorial Primitives	115
6.3	Off-the-Shelf Shape Descriptors Applied to Vectorial Data	116
6.3.1	Geometric Moments	117
6.3.2	Simple Shape Description Ratios	118
6.3.3	Fourier Descriptors	119
6.4	Multidimensional Hashing to Index Primitives	119
6.5	Relational Indexing and Hypotheses Validation	121
6.5.1	Relational Indexing	121
6.5.2	Voting Scheme	123
6.6	Experimental Results	124
6.7	Conclusions and Discussion	126
	References	129

Part IV A Performance Evaluation Protocol for Symbol Spotting Systems

7	Performance Evaluation of Symbol Spotting Systems	133
7.1	Introduction	133
7.2	Related Work	135
7.3	An Overview on Measures to Evaluate Retrieval Effectiveness	136
7.3.1	Precision and Recall	136
7.3.2	$P@n$ and $P(r)$	137
7.3.3	Precision and Recall Plots	138
7.3.4	Measures of Quality	138
7.3.5	Fall-out and Generality	139
7.3.6	Central Tendency of Precision and Recall	141
7.4	Precision and Recall for Spotting Systems	141
7.4.1	Precision and Recall of Regions of Interest	142
7.4.2	Measures of Quality, Fall-out and Generality	143
7.4.3	Measures at Symbol Level	144
7.4.4	Scalability Test	145
7.5	Evaluating a Symbol Spotting System	145
7.5.1	Ground-Truthing	146

7.5.2	Spotting Methods Under Test	148
7.5.3	The FPLAN-POLY Dataset	149
7.5.4	Evaluation	150
7.6	Conclusions and Discussion	156
	References	157
8	Conclusions	161
8.1	Summary of Contributions	161
8.2	Discussion	163
8.3	Open Challenges	165
	References	166
	Appendix A Databases	167
A.1	GREC 2005 Database	167
A.1.1	Variation GREC-SEG	171
A.1.2	Variation GREC-POLY	172
A.2	MPEG Database	172
A.2.1	Variation MPEG-POLY	173
A.3	FPLAN-POLY Database	175
	References	177
	Index	179

Symbol Spotting in Digital Libraries
Focused Retrieval over Graphic-rich Document
Collections

Rusiñol, M.; Lladós, J.

2010, XIV, 180 p., Hardcover

ISBN: 978-1-84996-207-0