# Contents

**中文摘要** **i**

**English Abstract** **iii**

**Acknowledgment** **v**

**Table of Contents** **vii**

**List of Figures** **ix**

**List of Tables** **xi**

**1 Introduction** **1**

**2 Background** **5**

2.1 Content-based Image Search Systems . . . . . 5

2.1.1 Content-based Image Retrieval Model . . . . . 5

2.1.2 Relevance Feedback . . . . . 12

2.1.3 Accuracy Measurements . . . . . 20

2.2 Digital Rights Management . . . . . 23

2.2.1 Digital Media Lifetime . . . . . 23

2.2.2 The Conditional Access in DTV . . . . . 25

2.2.3 A Watermarking Scheme . . . . . 27

2.2.4 The Embedding Algorithm . . . . . 27

2.2.5 The Extraction Algorithm . . . . . 28

**3 Image Retrieval with Relevance Feedback** **30**

3.1 Distance Distribution over Image Database . . . . . 31

3.2 Design Goals . . . . . 36

3.3 Feature Weighting Method . . . . . 37

3.4 Negative Instances . . . . . 42

3.5 Pseudo Instances . . . . . 44

3.6 Architecture . . . . . 45

3.7 Experiments and Discussions . . . . . 47

3.7.1 Simulation Environment . . . . . 47
3.7.2 Simulation Results . . . . . 49
3.8 Another Distance Measure . . . . . 58
3.9 ANMRR and Precision/Recall Comparisons . . . . . 61
3.10 Summary . . . . . 70

**4 Layered Access Control on Watermarked Scalable Media 72**
4.1 Motivation and Goals . . . . . 72
4.2 Recursive Data Flow Structures . . . . . 74
4.2.1 Scalable Coding . . . . . 74
4.2.2 Typical Streaming Encryption . . . . . 75
4.3 Proposed Protection Scheme . . . . . 77
4.3.1 Combination . . . . . 78
4.3.2 Receiver Architecure . . . . . 79
4.4 Application 1: Scalable-Compressed Images . . . . . 82
4.5 Application 2: Scalable-Compressed Video . . . . . 85
4.6 Summary . . . . . 91

**5 Conclusions 95**

**A A Design of MPEG-7 Testbed 99**
A.1 Motivations . . . . . 99
A.2 System Architecture . . . . . 100
A.3 Framework Implementation . . . . . 102
A.4 Applications . . . . . 104

**B IPMPX Implementation 106**
B.1 IPMPX Overview . . . . . 106
B.2 Design and Implementation . . . . . 108

**Bibliography 111**

# List of Figures


2.1 Fundamental steps in digital image processing. . . . . 7
2.2 The scope of the MPEG-7 standard. . . . . 8
2.3 Sources of general knowledge ordered as classes of equality. . . . . 13
2.4 A simplified QBIC architecture. . . . . 16
2.5 The life of a digital content. . . . . 24
2.6 A typical MPEG-2 conditional access receiver. . . . . 26

3.1 Distance distributions of Color Layout in databases. . . . . 33
3.2 Distance distributions of Edge Histogram in databases. . . . . 34
3.3 Distance distributions of Scalable Color in databases. . . . . 35
3.4 Subjective result of multi-instance effects. . . . . 41
3.5 The two interfering groud-truth sets in Fig. 3.4(a). . . . . 41
3.6 Pruning area in the combined feature space. . . . . 43
3.7 Subjective result of negative instance effects. . . . . 44
3.8 Subjective result of pseudo instance effects. . . . . 45
3.9 Proposed perception estimation and query system. . . . . 46
3.10 Two example simulation results. . . . . 51
3.11 Precision and recall curves of positive-only query of Scheme A. . . . . 63
3.12 Precision and recall curves of positive-only query of Scheme B. . . . . 64
3.13 Precision and recall curves of positive-only query of Scheme D. . . . . 65
3.14 Precision and recall curves of positive-and-negative query of i/q=1. . 67
3.15 Precision and recall curves of positive-and-negative query of i/q=2. . 68
3.16 Precision and recall curves of positive-and-negative query of i/q=3. . 69

4.1 Recursive form of scalable decoding. . . . . 75
4.2 Concept of protecting streaming data. . . . . 77
4.3 Combination of decryption and decoding. . . . . 78
4.4 Decryption and decoding of layer-protected content. . . . . 80
4.5 A layered protected image encoder. . . . . 83
4.6 A layer-protected image for transmission. . . . . 84
4.7 A received and reconstructed image from an erroneous channel. . . . 85
4.8 One design example for the transmitter. . . . . 87
4.9 Embedded watermarks, generated from encrypted keys. . . . . 88
4.10 One design example for the transmitter. . . . . 89

4.11 Comparisons between the watermarked and the received frames. . . . 90
4.12 Extracted watermarks and keys from the received frames. . . . . 91

A.1 Architecture of the software platform. . . . . 101
A.2 MPEG-7 testbed domain classes. . . . . 103
A.3 Screen-shots of applications. . . . . 105

B.1 The relationships of various context types. . . . . 109
B.2 The relationships of IPMPX components and the Testbed. . . . . 110

# List of Tables


3.1 Best $log(ANMRR)$ of spatial-scaled pseudo images (pos-only). . . . . 53
3.2 Best $log(ANMRR)$ of SNR-scaled pseudo images (pos-only). . . . . 54
3.3 Best $log(ANMRR)$ of spatial-scaled pseudo images (pos-and-neg). . . 56
3.4 Best $log(ANMRR)$ of SNR-scaled pseudo images (pos-and-neg). . . . 57
3.5 Best $Log(ANMRR)$ of Scheme D for all Query Schemes. . . . . 60
3.6 $log(ANMRR)$ of SNR-scaled pseudo images (positive-only). . . . . 62
3.7 $log(ANMRR)$ of SNR-scaled pseudo images (positive-and-negative). . 66

4.1 BCR after the JPEG compression and the data transmission. . . . . 92
4.2 Key Correction Ratio (KCR) under various Bit Error Rates (BER). . 93