

TABLE OF CONTENTS

| | Page No. |
|--|-----------|
| Certificate..... | ii |
| Acknowledgement..... | v |
| Abstract..... | v |
| List of Publications..... | ix |
| List of Table(s)..... | x |
| List of Figure(s)..... | xi |
| | |
| Chapter 1 Introduction..... | 1 |
| 1.1 Problem Statement..... | 2 |
| 1.2 Objective..... | 2 |
| 1.3 Scope..... | 3 |
| 1.4 Product Functions..... | 3 |
| 1.5 Organisation of the Dissertation..... | 4 |
| | |
| Chapter 2 Literature Review..... | 5 |
| 2.1 Image Processing..... | 6 |
| 2.1.1 Digital Images..... | 6 |
| 2.1.2 Image processing operations..... | 7 |
| 2.2 Image understanding..... | 12 |
| 2.2.1 Steps involved in image understanding..... | 13 |
| 2.2.2 Image understanding techniques..... | 16 |
| 2.2.2.1 sparse coding..... | 17 |
| 2.2.2.2 knowledge based..... | 18 |

| | |
|---|----|
| 2.2.2.3 Fuzzy logic based..... | 21 |
| 2.2.2.4 neural network based..... | 23 |
| 2.2.2.5 cognitive approach..... | 24 |
| 2.2.2.6 decision tree..... | 25 |
| 2.2.2.6.1 using decision trees for classification..... | 27 |
| 2.2.2.6.2 types of decision trees..... | 27 |
| 2.2.2.6.3 advantages of decision trees..... | 27 |
| 2.2.2.6.4 limitations of decision trees..... | 28 |
| 2.3 image retrieval..... | 28 |
| 2.3.1 traditional image retrieval system..... | 28 |
| 2.3.2 difficulties of a content based image retrieval system..... | 30 |
| 2.3.3 general content based image retrieval system..... | 31 |
| 2.4 feature extraction..... | 33 |
| 2.5. color..... | 33 |
| 2.5.1 color spaces..... | 34 |
| 2.5.2 color based feature extraction techniques..... | 35 |
| 2.5.2.1.color moments..... | 35 |
| 2.5.2.2 color moments with fuzzy regions..... | 36 |
| 2.5.2.3 color histogram..... | 38 |
| 2.6 Texture..... | 39 |
| 2.6.1 Texture Based Feature Extraction Techniques..... | 40 |
| 2.6.1.1 Grey Level Co-Occurrence Matrix..... | 40 |
| 2.6.1.2 Gabor Filter..... | 42 |
| 2.7 Shape..... | 43 |
| 2.7.1 Shape Based Feature Extraction Techniques..... | 44 |
| 2.7.1.1 Moment Invariants..... | 44 |
| 2.7.1.2. Grid Based..... | 45 |

| | |
|---|-----------|
| Chapter 3 Proposed System: PRISM -Analysis & Design..... | 47 |
| 3.1 project definition..... | 48 |
| 3.2 System requirement Analysis..... | 49 |
| 3.2.1 identification of requirements..... | 49 |
| 3.2.2 Preliminary Investigation..... | 49 |
| 3.2.3 Feasibility Study..... | 49 |
| 3.2.4 External Interfaces..... | 50 |
| 3.2.5 Hardware Requirements..... | 50 |
| 3.2.6 Software Requirements..... | 51 |
| 3.2.7 Memory Constraints..... | 51 |
| 3.2.8 Functional Requirements..... | 51 |
| 3.2.9 Use Case Diagrams..... | 51 |
| 3.2.10 Performance Requirements..... | 61 |
| 3.2.10.1 User Interface..... | 61 |
| 3.2.11 Logical Database Requirements..... | 61 |
| 3.3 System design..... | 61 |
| 3.3.1 Data Flow Diagrams..... | 61 |
| 3.3.2 Activity Diagrams..... | 66 |
| 3.3.3 layered architecture and block diagram of system..... | 70 |
| 3.4 Database Descriptions..... | 73 |
| 3.5 Algorithms of the proposed system..... | 75 |
| 3.5.1 Feature Extraction Techniques..... | 75 |
| i. Color Moments..... | 75 |
| ii. Fuzzy Color Moments..... | 78 |
| iii. Color Histogram..... | 81 |
| iv. Texture GLCM..... | 81 |
| v. Moment Invariant..... | 83 |
| 3.5.2 Pattern Recognition..... | 85 |

| | |
|--|------------|
| i. Object Based Recognition..... | 85 |
| ii. Target Based Recognition..... | 85 |
| 3.6 Code Efficiency..... | 87 |
| 3.7 Validation Checks..... | 87 |
| 3.8 Certain Issues raised in development..... | 88 |
| | |
| Chapter 4 Results & Analysis..... | 89 |
| | |
| Conclusion & Future Work..... | 100 |
| Conclusion..... | 101 |
| Future Work..... | 102 |
| | |
| References..... | 103 |
| | |
| Appendix 1: Implementation Details..... | 107 |
| | |
| Appendix 2: Screen Layouts..... | 115 |
| | |
| Appendix 3: Publication..... | 130 |

LIST OF PUBLICATION

Conference Name: International IT Summit, ‘Confluence – The Next Generation Information Technology’

Paper Title: Feature Extraction Methods for Content Based Image Retrieval

Authors: Chesta Agarwal

Paper Attached in Appendix 3.

LIST OF TABLE(S)

| | |
|---|----|
| Table 3.1: Hardware Requirement of the system..... | 50 |
| Table 3.2: Software Requirement of the system..... | 51 |
| Table 3.3: Algorithms for various project modules..... | 75 |
| Table 4.1: Comparison of various feature extraction techniques..... | 99 |

LIST OF FIGURE(S)

| | |
|--|----|
| Figure 2.1: Digitization of continuous image..... | 7 |
| Figure 2.2: Original Image..... | 8 |
| Figure 2.3: Image after restoration..... | 8 |
| Figure 2.4: Original Image before Image Enhancement..... | 9 |
| Figure 2.5: Image after Image Enhancement..... | 9 |
| Figure 2.6: Original Image before Image Compression..... | 10 |
| Figure 2.7: Image after compression..... | 10 |
| Figure 2.8: Original Image before Image Segmentation..... | 11 |
| Figure 2.9: Image after Segmentation..... | 12 |
| Figure 2.10: Relationship between Image data and level of image understanding..... | 13 |
| Figure 2.11: Image Understanding Steps..... | 15 |
| Figure 2.12: Illustration of sparse probability density..... | 17 |
| Figure 2.13: A general knowledge based image understanding system..... | 19 |
| Figure 2.14: Examples of image scenes..... | 21 |
| Figure 2.15: Fuzzy logic based image understanding system..... | 23 |
| Figure 2.16: Sample Decision Tree..... | 25 |
| Figure 2.17: Sample Training Data..... | 26 |
| Figure 2.18: Example-Using Decision Tree for classification..... | 27 |
| Figure 2.19: Traditional architecture of image retrieval..... | 29 |
| Figure 2.20: A typical Content Based Image Retrieval System..... | 31 |
| Figure 2.21: Partitioning image into fuzzy regions, Membership matrix..... | 37 |
| Figure 2.22: Image with an Example Histogram..... | 38 |

| | |
|--|----|
| Figure 2.23: Few examples of different textures..... | 39 |
| Figure 2.24: Example calculation of co-occurrence matrix..... | 42 |
| Figure 2.25: Imposing figures on the grid to get index..... | 45 |
| Figure 2.26: Normalisation of a figure with respect to the major axis..... | 46 |
| Figure 3.1: Use case diagram: system..... | 59 |
| Figure 3.2: Use case diagram: actor..... | 60 |
| Figure 3.2: System DFD..... | 62 |
| Figure 3.3: 1 st Level DFD: System Description..... | 62 |
| Figure 3.4: Level 2 DFD: Database Management..... | 63 |
| Figure 3.5: Level 2 DFD: Image Handling..... | 63 |
| Figure 3.6: Level 2 DFD: Feature Extraction..... | 64 |
| Figure 3.7: Level 2 DFD: Pattern Recognition..... | 64 |
| Figure 3.8: Level 2 DFD: Image Analysis..... | 65 |
| Figure 3.9: Object Based Recognition Activity Diagram..... | 66 |
| Figure 3.10: Target Based Recognition Activity Diagram..... | 67 |
| Figure 3.11: Image Understanding Activity Diagram..... | 68 |
| Figure 3.12: Database Connectivity Activity Diagram..... | 69 |
| Figure 3.13: Layered Architecture..... | 63 |
| Figure 3.14: Block Diagram of PRISM..... | 70 |
| Figure 4.1: Distance Comparison for color moments..... | 90 |
| Figure 4.2: Distance Comparison for fuzzy color moments..... | 91 |
| Figure 4.3: Distance Comparison for color histogram..... | 92 |
| Figure 4.4: Distance Comparison for texture glcm..... | 93 |
| Figure 4.5: Distance Comparison for gabor filter..... | 94 |

| | |
|--|----|
| Figure 4.6: Distance Comparison for moment invariant..... | 95 |
| Figure 4.7: Comparison for time analysis for various techniques..... | 96 |
| Figure 4.8: Comparison for time analysis for color techniques..... | 97 |
| Figure 4.9: Comparison of accuracy percentage of pattern recognition for different techniques..... | 98 |