HIGHER TECHNICAL INSTITUTE

COMPUTER STUDIES DEPARTMENT

DIPLOMA PROJECT

ANALYSIS AND IMPLEMENTATION OF AN ALGORITHM FOR THE CALCULATION OF A SORTED DATA STRUCTURE OF 2D OR 3D POINTS FROM A SET OF SCATTERED DATA

CS/142

SYSTEM'S ANALYSIS

Designed and Implemented by:

MARINOS TATTARIS
RENOS MINOSHIS
SIMEOU SIMOS

JUNE 1995

HIGHER TECHNICAL INSTITUTE | PROJECT NO. 2388

Summary

ANALYSIS AND IMPLEMENTATION OF AN ALGORITHM FOR THE CALCULATION OF A SORTED DATA STRUCTURE OF 2D OR 3D POINTS FROM A SET OF SCATTERED DATA

Project CS/142
Higher Technical Institute

MARINOS TATTARIS
RENOS MINOSHIS
SIMEOU SIMOS

Having a system that gives you the ability to reconstruct a 3D object and at the same time visualize it on the screen can be very helpful, because you can view and analyze the object completely. Up to now, the existing imaging systems produce only 2D images and the development of a 3D reconstruction system can be described as a revolutionary step in the computer science.

The subject of this project is a part of the EU-project, suggested by the European Union to the Higher Technical Institute, called "KIT" (Keep In Touch).

It is important to emphasize that the purpose of this project is not to make the perfect 3D Reconstruction System, but to fill in the gab between the existing 2D Imaging System and a perfect 3D Reconstruction System. Project CS/142 makes an attempt to solve this problem.

CONTENTS

Summary
About this book
Acknowledgements 1

INTRODUCTION 2

CHAPTER 1: INITIAL INVESTIGATION
1.1 General about reconstruction 4
1.2 General about sorting 4
1.2.1 Introduction 4
1.2.2 Rules for sorting 5
1.2.3 Sorting categories 6

CHAPTER 2: ANALYSIS AND GENERAL DESIGN
2.1 Reconstruction 8
2.1.1 Surface reconstruction 8
2.1.2 Volume reconstruction 9
2.1.3 Reconstruction methods and procedures 10
2.2 Sorting Algorithms 11
2.2.1 Internal Sorting 11
2.2.1.1 Elementary Algorithms 11
- Selection Sort 11
- Insertion Sort 14
- Bubble Sort 17
2.2.1.2 Sorting Files With Large Records 19
- Shellsort 19
- Distribution Counting Sort 21
2.2.1.3 Advanced Sorting Algorithms 24
- Quicksort 24
- The Basic Algorithm 24
- Removing Recursion 28
- Small Subfiles 31
- Median Of Three Partitioning 31
- Randix Sorting 32
- Bits 33

- Randix Exchanged Sort 34
- Straight Randix Sort 38
- Linear Sort 40
- Priority Queues 40
- Elementary Implementations 42
- Heap Data Structure 44
- Algorithms On Heaps 46
- Heap Sort 50
- Merge Sort 52
- Mergesort 55
- List Mergesort 56
- Bottom-Up Mergesort 58

2.2.2 External Sorting 62
- Sort Merge 63
- Balanced Multiway Merging 63
- Replacement Selection 64

2.3 Selection of tools for system development 66

2.3.1 The Ansi C language 66
2.3.1.1 History of C 66
2.3.1.2 Why use Ansi C for developing the project 66
2.3.2 The UNIX Operating System 67
2.3.3 The user interface 68
2.3.3.1 The X Window System 68
2.3.3.2 Xlib 68
2.3.3.3 X Toolkit Intrinsics 69
2.3.3.4 Motif 87
2.3.3.5 Widgets 89
2.3.4 The OpenGL (Open Graphics Library) 93
2.3.4.1 Viewing 93
2.3.4.1.1 Viewing transformation 94
2.3.4.1.2 Modeling transformation 94
2.3.4.1.3 Projection transformation 96
2.3.4.1.4 Viewport transformation 97
2.3.4.2 Clipping 97
2.3.4.3 Light 98
2.3.4.4 Fog 99

2.4 System Requirements 100
2.4.1 Objectives of the project 100

CHAPTER 3: DETAILED DESIGN AND IMPLEMENTATION
3.1 New system design 102
3.1.1 Data files 102
3.1.2 Security and control measures 102
3.2 Implementation and Installation planning 102
3.2.1 Implementation planning 102
3.2.2 Installation planning 103
3.2.3 Hardware alternatives 103
3.3 Technical design 103
3.3.1 Screen design 103
3.3.2 Messages and user interface 103
3.3.3 On-line help facility 104
3.4 Test specifications and planning 104
3.5 Code protection 104
3.6 User training 104
3.7 System test 105

CHAPTER 4: INSTALLATION
4.1 Installation phase 106
4.1.1 File conversion 106
4.1.2 System installation 106

CHAPTER 5: REVIEW
5.1 Review phase 107
5.1.1 Development recap 107
5.1.2 Post implementation review 107

REFERENCES
CONCLUSION
APPENDICES

FIGURES

Figure 1-1:	Sorting Categories	7
Figure 2-1:	Steps followed in 3D reconstruction	11
Figure 2-2:	Selection Sort	13
Figure 2-3:	Example of Insertion Sort	16
Figure 2-4:	Example of Shell Sort	21
Figure 2-5:	Example of Distribution Counting Sort	23
Figure 2-6:	Example of Quick Sort	28
Figure 2-7	Example of Quick Sort when removing recursion	30
Figure 2-8:	Example of Randix Exhchange Sort with small subfiles	37
Figure 2-9:	Complete tree representation of a heap	45
Figure 2-10:	Array representation of a heap	45
Figure 2-11:	Example of Merge Sort with recursion	57
Figure 2-12:	Example of Merge Sort without recursion	61
Figure 2-13:	X Window System Hierarchy	72
Figure 2-14:	The Software Architecture of Xt Intrinsics - based applications	83
Figure 2-15:	Widget and Gadget Hierarchy	88
Figure 2-16:	Basic Widget Hierarchy	89
Figure 2-17:	Object translation	95
Figure 2-18:	Object rotation	95