



Silesian
University
of Technology

FINAL PROJECT

Desktop application supporting learning of stereometry

Adrian BEDNORZ
Student identification number: ab306018

Programme: Informatics
Specialisation: Computer Graphics and Software

SUPERVISOR
dr inż. Alina Momot
DEPARTMENT Katedra Informatyki Stosowanej
Faculty of Automatic Control, Electronics and Computer Science

Gliwice 2025

Thesis title

Desktop application supporting learning of stereometry

Abstract

The aim of the work is to design and implement a desktop application that supports children in learning geometry. The user of the application will have several types of tasks to choose from, in which it will be necessary to calculate the areas and volumes of three-dimensional geometric figures. There will also be an educational component where it will be possible to visualize the changes in the areas and volumes of the figures as the parameters describing the figure are altered.

Key words

application, education, geometry, stereometry

Tytuł pracy

Aplikacja na komputer stacjonarny wspomagająca naukę stereometrii

Streszczenie

Celem pracy jest zaprojektowanie i wdrożenie aplikacji desktopowej wspomagającej dzieci w nauce geometrii. Użytkownik aplikacji będzie miał do wyboru kilka typów zadań, w których będzie musiał obliczyć pola i objętości trójwymiarowych figur geometrycznych. Aplikacja będzie również zawierać część edukacyjną, umożliwiającą wizualizację zmian pól i objętości figur wraz ze zmianą parametrów opisujących figurę.

Słowa kluczowe

aplikacja, edukacja, geometria, stereometria

Contents

1	Introduction	1
2	[Problem analysis]	3
3	Requirements and tools	5
4	External specification	7
5	Internal specification	9
6	Verification and validation	11
7	Conclusions	13
	Bibliography	15
	Index of abbreviations and symbols	19
	Listings	21
	List of additional files in electronic submission (if applicable)	23
	List of figures	25
	List of tables	27

Chapter 1

Introduction

- introduction into the problem domain
- settling of the problem in the domain
- objective of the thesis
- scope of the thesis
- short description of chapters
- clear description of contribution of the thesis's author – in case of more authors table with enumeration of contribution of authors

Chapter 2

[Problem analysis]

- problem analysis
- state of the art, problem statement
- literature research (all sources in the thesis have to be referenced [2, 1, 3, 4])
- description of existing solutions (also scientific ones, if the problem is scientifically researched), algorithms, location of the thesis in the scientific domain

Mathematical formulae

$$y = \frac{\partial x}{\partial t} \tag{2.1}$$

and single math symbols x and y are typeset in the mathematical mode.

body of the definitions

Chapter 3

Requirements and tools

- functional and nonfunctional requirements
- use cases (UML diagrams)
- description of tools
- methodology of design and implementation

Chapter 4

External specification

- hardware and software requirements
- installation procedure
- activation procedure
- types of users
- user manual
- system administration
- security issues
- example of usage
- working scenarios (with screenshots or output files)

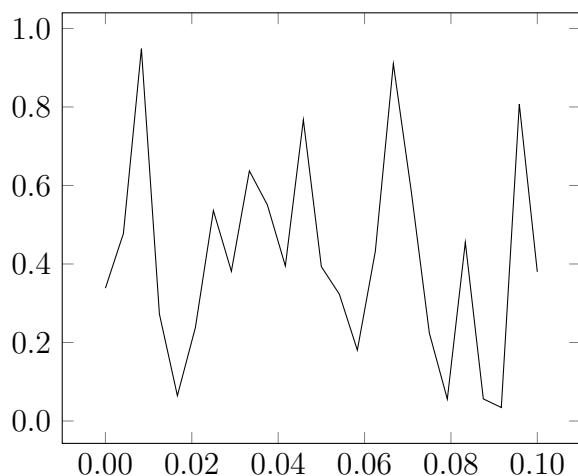


Figure 4.1: Figure caption (below the figure).

Chapter 5

Internal specification

- concept of the system
- system architecture
- description of data structures (and data bases)
- components, modules, libraries, resume of important classes (if used)
- resume of important algorithms (if used)
- details of implementation of selected parts
- applied design patterns
- UML diagrams

Use special environments for inline code, eg `int a;` (package `listings`). Longer parts of code put in the figure environment, eg. code in Fig. 5.1. Very long listings—move to an appendix.

```
1 class test : public basic
2 {
3     public:
4         test (int a);
5         friend std::ostream operator<<(std::ostream & s,
6                                         const test & t);
7     protected:
8         int _a;
9
10 };
```

Figure 5.1: Pseudocode in listings.

Chapter 6

Verification and validation

- testing paradigm (eg V model)
- test cases, testing scope (full / partial)
- detected and fixed bugs
- results of experiments (optional)

Table 6.1: A caption of a table is **above** it.

ζ	method							
	alg. 1	alg. 2	alg. 3			alg. 4, $\gamma = 2$		
			$\alpha = 1.5$	$\alpha = 2$	$\alpha = 3$	$\beta = 0.1$	$\beta = -0.1$	
0	8.3250	1.45305	7.5791	14.8517	20.0028	1.16396	1.1365	
5	0.6111	2.27126	6.9952	13.8560	18.6064	1.18659	1.1630	
10	11.6126	2.69218	6.2520	12.5202	16.8278	1.23180	1.2045	
15	0.5665	2.95046	5.7753	11.4588	15.4837	1.25131	1.2614	
20	15.8728	3.07225	5.3071	10.3935	13.8738	1.25307	1.2217	
25	0.9791	3.19034	5.4575	9.9533	13.0721	1.27104	1.2640	
30	2.0228	3.27474	5.7461	9.7164	12.2637	1.33404	1.3209	
35	13.4210	3.36086	6.6735	10.0442	12.0270	1.35385	1.3059	
40	13.2226	3.36420	7.7248	10.4495	12.0379	1.34919	1.2768	
45	12.8445	3.47436	8.5539	10.8552	12.2773	1.42303	1.4362	
50	12.9245	3.58228	9.2702	11.2183	12.3990	1.40922	1.3724	

Chapter 7

Conclusions

- achieved results with regard to objectives of the thesis and requirements
- path of further development (eg functional extension . . .)
- encountered difficulties and problems

Bibliography

- [1] Name Surname and Name Surname. *Title of a book*. Hong Kong: Publisher, 2017. ISBN: 83-204-3229-9-434.
- [2] Name Surname and Name Surname. ‘Title of an article in a journal’. In: *Journal Title* 157.8 (2016), pp. 1092–1113.
- [3] Name Surname, Name Surname and N. Surname. ‘Title of a conference article’. In: *Conference title*. 2006, pp. 5346–5349.
- [4] Name Surname, Name Surname and N. Surname. *Title of a web page*. 2021. URL: <http://somewhere/on/the/internet.html> (visited on 30/09/2021).

Appendices

Index of abbreviations and symbols

DNA deoxyribonucleic acid

MVC model–view–controller

N cardinality of data set

μ membership function of a fuzzy set

\mathbb{E} set of edges of a graph

\mathcal{L} Laplace transformation

Listings

(Put long listings here.)

```
1 if (_nClusters < 1)
2   throw std::string ("unknown number of clusters");
3 if (_nIterations < 1 and _epsilon < 0)
4   throw std::string ("You should set a maximal number of
      iteration or minimal difference --- epsilon .");
5 if (_nIterations > 0 and _epsilon > 0)
6   throw std::string ("Both number of iterations and minimal
      epsilon set --- you should set either number of iterations
      or minimal epsilon .");
```

List of additional files in electronic submission (if applicable)

Additional files uploaded to the system include:

- source code of the application,
- test data,
- a video file showing how software or hardware developed for thesis is used,
- etc.

List of Figures

4.1	Figure caption (below the figure).	7
5.1	Pseudocode in <code>listings</code> .	10

List of Tables

6.1 A caption of a table is above it.	12
--	----