GDAŃSK UNIVERSITY
OF TECHNOLOGY

FACULTY OF ELECTRONICS, TELECOMMUNICATIONS
AND INFORMATICS

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Second cycle studies
Mode of study: Full-time studies
Field of study: Informatics
Specialization: distributed applications and
internet services

## MASTER'S THESIS

Title of thesis: Decision support system for assessment of retinal arteries width based on time-series
of fundus images

Title of thesis (in Polish): System wspomagający ocenę zmian przekroju tętnic w serii czasowej
obrazów kolorowych dna oka

| Supervisor | Head of Department |
|---|---|
| *signature* | *signature* |
| dr inż. Tomasz Dziubich | |

Date of thesis submission to faculty office:

**STATEMENT**

First name and surname: Michał Miszczyszyn
Date and place of birth: 18.01.1992, Gdańsk
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Faculty: Faculty of Electronics,Telecommunications and Informatics
Field of study: informatics
Cycle of studies: postgraduate studies
Mode of studies: Full-time studies

I, the undersigned, agree/do not agree* that my diploma thesis entitled: Decision support system for assessment of retinal arteries width based on time-series of fundus images may be used for scientific or didactic purposes.[1]

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Aware of criminal liability for violations of the Act of 4th February 1994 on Copyright and Related Rights (Journal of Laws 2006, No. 90, item 631) and disciplinary actions set out in the Law on Higher Education (Journal of Laws 2012, item 572 with later amendments),[2] as well as civil liability, I declare that the submitted diploma thesis is my own work.

This diploma thesis has never before been the basis of an official procedure associated with the awarding of a professional title.

All the information contained in the above diploma thesis which is derived from written and electronic sources is documented in a list of relevant literature in accordance with art. 34 of the Copyright and Related Rights Act.

I confirm that this diploma thesis is identical to the attached electronic version.

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[1] Decree of Rector of Gdańsk University of Technology No. 34/2009 of 9th November 2009, TUG archive instruction addendum No. 8.

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Art. 214, section 4. Should a student be suspected of committing an act which involves the appropriation of the authorship of a major part or other elements of another person's work, the rector shall forthwith order an enquiry.

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## ABSTRACT

The **Abstract** should include a definition of the scientific or practical problem to be solved, the aim and scope of the thesis, the applied methods of research, the results and the most important conclusions.

If the thesis is written by more than one author, the **Abstract** must specify what each author has prepared and contributed. Moreover, the particular authorship of each chapter and subchapter must also be specified (see **Table of Contents**). If a writer is named as the author of a particular subchapter it should be assumed that all the items in the subchapter are the work of that particular writer. For example, if the thesis is co-authored by writer A and writer B, in the Table of Contents it may be stated that writer A co-authored chapters 1 and 7, individually authored chapter 2 as well as subchapters 3.1 and 4.2, etc. A writer B, on turn, may be named as the co-author of chapters 1 and 7 as well as the individual author of subchapters 3.2 and 4.1, etc.


**Keywords:**


**Field of science and technology in accordance with OECD requirements**: <field>, <technology>,...

# STRESZCZENIE

The **Streszczenie** should correspond to the **Abstract** and includes the same key elements. It should be prepared according to faculty rules. The **Streszczenie** is a chapter written only by Polish authors who decide to write the diploma thesis in English and it is not applicable to foreign students.

**Słowa kluczowe**: [keywords] Zażółć gęślą jaźń.

**Dziedzina nauki i techniki, zgodnie z wymogami OECD**: <dziedzina>, <technika>,... [field of science and technology in accordance with OECD requirements: <field>, <technology>,... ]

# TABLE OF CONTENTS

# LIST OF IMPORTANT SYMBOLS AND ABBREVIATIONS

OD      —      Optic Disc

DD      —      Optic Disc diameter

ROI      —      Region Of Interest

AVR      —      arteriole-to-venule diameter ratio

# 1. TITLE OF CHAPTER 2

Some references [1–4]. Klonoff and Schwartz [5] has stated that...

The general formatting requirements for the diploma thesis are listed below:

- sheet size: A4,
- paper orientation: vertical,
- font: Arial,
- basic font size: 10 pt.,
- line spacing: 1.5,
- mirror margins:
  - top: 2.5 cm,
  - bottom: 2.5 cm,
  - internal: 3.5 cm,
  - external: 2.5 cm,
- the thesis text should be justified (aligned to both margins),
- each paragraph should begin with a 1.25 cm indentation.

The thesis should be prepared for double-sided printing. The page numbering should be in the page footer and centred. The title page should include the author's (authors') Statement (Statements) and the page number should not be printed. Page numbering, should be in Arabic numerals using a 9 pt. Arial font. It should begin on page 3 (the Table of Contents) and continue to the last page.

An example of the correct way of presenting information in points (bulleted list) is shown above. Each point (line of text) should be preceded by a bullet. It should begin in the lower case and end with a comma or semi-colon, except for the last point (line of text), which should end with a full stop.

The title of a table should be directly above the table, with a 9 pt. font size and not ended with a full stop, as shown above. Paragraph spacing for the text in the table is as follows:

- top 6 pt.,
- bottom 0 pt.

The correct headings are presented in Table 1.1.

**Table 1.1.** Sizes and styles of headings

| Level of heading | Example | Font size and style |
| --- | --- | --- |
| Heading 1 | **1. CHAPTER TITLE** | 12 pt., CAPITALS, bold |
| Heading 2 | ***1.1. Subchapter title*** | 10 pt., bold and in italics |
| Heading 3 | *1.1.1. Subchapter section* | 10 pt., italics |

Data should be presented in the table as in Table 1.1, shown above, i.e. using a 9 pt. font and aligning text to the left edge of the cell.

Table numbering is continuous within the chapter. The table sequence number (table title) is preceded by the word Table and the number of the chapter, ended with a dot (e.g. Table 1.1. Size...). Every table must be referred to in the thesis text, e.g.'Table 1.1. contains...'.

If a table needs to be continued on more than one page, the table heading should appear on each subsequent page, using the option: TABLE PROPERTIES -> row -> repeat as heading row at the top of every page.

The first paragraph below a table should begin with a top margin of 12 pt.

Lines of text should not end with short prepositions, such as: a, an, the, in, on, etc. In such cases the non-breaking space (NBSP), using ctrl, shift and space, is recommended instead of an ordinary space

The title of a subsequent chapter should always appear on a new page. Every paragraph containing the title of a chapter or subchapter has the following intervals:

- top 12 pt.,
- bottom 6 pt.

Here is some text to get rid of Underfull Badbox. Here is some text to get rid of Underfull Badbox. Here is some text to get rid of Underfull Badbox. Here is some text to get rid of Underfull Badbox. Here is some text to get rid of Underfull Badbox. Here is some text to get rid of Underfull Badbox. Here is some text to get rid of Underfull Badbox. Here is some text to get rid of Underfull Badbox. Here is some text to get rid of Underfull Badbox. Here is some text to get rid of Underfull Badbox. Here is some text to get rid of Underfull Badbox. Here is some text to get rid of Underfull Badbox. Here is some text to get rid of Underfull Badbox. Here is some text to get rid of Underfull Badbox. Here is some text to get rid of Underfull Badbox. Here is some text to get rid of Underfull Badbox. Here is some text to get rid of Underfull Badbox.

### *1.1. Subchapter title*

References in the text to literature should show in square brackets their reference number from the **Bibliography** or the name of the author/s and year of publication [Kowalski J., 2002] and page number in the case of citations [Kowalski J., 2002, p. 3].

The **Bibliography** should be arranged alphabetically or in the order items are mentioned in the chapter. If several items of literature are referred to at one point in the text, a dash may be used in the square brackets [1-5] if they are in consecutive order in the **Bibliography**, or if their order is not consecutive, using commas, as follows: [1, 3, 5].

An example of bibliographic entries is shown in the Bibliography chapter.

Figures are numbered in the order in which they appear in the chapter. In the caption below a figure, the number of the figure is preceded by the abbreviation 'Fig.' and the appropriate chapter number, e.g. 'Fig. 2.1.'

Figures appearing in the thesis should be centred. The spacing in a paragraph containing a figure should be:

- top 12 pt,
- bottom 0 pt.

Every figure must be referred to in the text, for example as follows: 'Fig. **??**. presents. . . '.

If the thesis is written in English, all the tables and figures must also be presented in the English language.

An example of a properly presented figure and caption is provided below.

The caption below the figure should be centered, have a 9 pt. font size and end with a full stop. The top margin should be 6 pt., the bottom margin 12 pt. and the spacing should be single.

The first paragraph below a figure should have a top margin of 12 pt.

### 1.1.1. Subchapter section heading

Every paragraph containing a subchapter section heading should have the following spacing:

- top 12 pt.,
- bottom 6 pt.

## 1.2. Subchapter heading

Variables should be written in italics, e.g. $x, ni, ni + 1$, whereas symbols denoting vectors or matrices should be written in bold, e.g. $\mathbf{v}, \mathbf{A}$. The minus sign should directly precede the number without a space, e.g. $-20$. There must always be a space between a numerical value and unit of measurement, e.g. 1 V or 10 km.

Preferably, the insertion of equations (INSERT -> Equation) directly into the text should be avoided. If there is a possibility of legibly inserting an equation in one line, it should be done as in the following examples: $1/2t^2$ or $e^{2x+1}$. This should be immediately followed by an explanation as to what the particular symbols denote, e.g. where: $t$ — time [s].

Equations that might become illegible when written in a single line should be written in a separate paragraph, e.g.

$$s = v_0 \cdot t + \frac{a \cdot t^2}{2}$$

(1.1)

where:
$s$     —     linear displacement with constant acceleration [m],
$v_0$     —     initial velocity [m/s],
$t$     —     time of object motion [s],
$a$     —     acceleration [m/s$^2$].

Every equation should be centered. Its number should be preceded by the chapter number and a dot, in parentheses. Every equation has to be referred to in the text, e.g. 'Equation (1.1) allows us to estimate...'.

Any footnotes should appear below a line at the bottom of the page,[1] and there numbering should be consecutive throughout the thesis. To make footnotes use NUMBERING OPTIONS -> add footnote.

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[1] Footnotes should be written using Arial 9 pt.

## 2. SUMMARY

Every diploma thesis must include a chapter entitled **Summary**. It should appear before the **Bibliography** and include a review of the main points of the thesis and/or obtained results. The chapter should also state what should be realized if research into the subject of the thesis is continued.

## BIBLIOGRAPHY

[1] M. Niemeijer, X. Xiayu, A. V. Dumitrescu, P. Gupta, B. van Ginneken, J. C. Folk, and M. D. Abramoff, "Automated measurement of the arteriolar-to-venular width ratio in digital color fundus photographs," *IEEE Transactions on Medical Imaging IEEE Trans. Med. Imaging*, vol. 30, pp. 1941–1950, 2011. [Online]. Available: http://www.ncbi.nlm.nih.gov/pubmed/21690008

[2] F. ter Haar, "Automatic localization of the optic disc in digital colour images of the human retina," Master's thesis, Utrecht University, The Netherlands, 2005.

[3] R. Wang, "Conversion from rgb to hsi," Oct. 2014. [Online]. Available: http://fourier.eng.hmc.edu/e161/lectures/ColorProcessing/node2.html

[4] E. P. Solomon, L. R. Berg, and D. W. Martin, *Biologia*, VII ed. Warszawa: MULTICO Oficyna Wydawnicza, 2007.

[5] D. C. Klonoff and D. M. Schwartz, "An economic analysis of interventions for diabetes," *Diabetes Care*, vol. 23, pp. 390–404, 2000. [Online]. Available: http://dx.doi.org/10.2337/diacare.23.3.390

**LIST OF FIGURES**

## LIST OF TABLES

# APPENDIX A. TITLE OF APPENDIX A

Appendices should be consecutively denoted with letters of the alphabet. An Appendix should include necessary supplementary data, e.g. calculations or schematic diagrams.

## APPENDIX B. TITLE OF APPENDIX B

Detailed guidelines regarding the content of Appendices should be established by the faculty, taking into account the specificity of a given field and course of study.