

Research Project

**Video surveillance system
for Intensive Care Unit**

At the Department of Computer Science
of the University of Applied Sciences and
Arts Dortmund

Course of study: Computer Science

Specialization: Embedded Systems Engi-
neering

Research Project

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Master of Engineering

by

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Overview

Note: In order to compile this template without errors, the compilation settings must be adjusted for different LaTeX editors (TeXmaker, TeXstudio, etc.). Biber must be selected as the default bibliography programme instead of BibTeX.

Note: This template is a work in progress. If you have any questions or comments, please contact louise.bloch@fh-dortmund.de.

Abstract

This should be an abstract of about half a page. The purpose of the abstract is to give the reader a compact overview of the entire thesis. It usually contains a compact presentation of the motivation, the research question, the methods used and the main results. The abstract must be understandable to the reader without knowledge of the rest of the thesis. It must not contain any information that goes beyond the content of the thesis. The abstract does not contain references. As a rule, you should write the abstract after you have completed the thesis. The aim is to provide a clear and focused summary of your work. This often takes several iterations.

With development LLM technologies the requirements from the world about truth events increased tremendously. Different methods, new technologies make information overflowing. New approaches should be investigated and implemented for the better results. Among surveillance technologies can be used different sensors: ultrasound, infrared, LIDAR, For taking a correct decision they can be used together as sensor fusion. In this project it was defined requirements to detect objects, their positions, defined if their position is inside defined area and de-

track human activities if someone is in the ICU. This information should be saved in appropriate form for future analysis. The sensors for this research project were defined as RGBD cameras, primarily the FEMTO Mega ORBBEC. The purpose of the project is to assess accuracy and overall performance of such surveillance system and prepare it to be in accordance with the law, regulatory and medical standards in the software and hardware development. The project should extract the most reasonable parameters of the surveillance system and assess the developed platform. The platform should later become a base for development of a Digital Twin for ICU.

Abstract

Hier findet eine deutsche Übersetzung des englischen „Abstract“ statt.

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Chapter 1

Introduction

IMPORTANT NOTE: Everything in this **draft** concerning the aspect of **scientific work** in the preparation of a Bachelor's/Master's thesis is absolutely **binding** and must be taken into account without exception! Everything in this **draft** concerning the **layout** of a Bachelor's/Master's thesis reflects the **personal** opinion of the authors! Every student can develop their own ideas! You can find some helpful pointers here.

Now for the introduction. What should it contain, among other things?

- Explanation of the problem
- Motivation for addressing the problem
- Reference to any existing related works
- Distinction of your thesis from any existing works
- Brief summary of the resulting objectives of the thesis
- Brief outline of the structure of the thesis

1.1 Explanation of the problem

ICU is one of the most important areas in clinics.

1.2 Motivation

This section introduces and motivates the problem investigated in the thesis.

1.3 Objective

The reader should be given a precise description of the objective of the work in a few sentences, so that he or she can critically evaluate the author's following statements in terms of goal-oriented work and goal achievement.

1.4 Structure of the thesis

At the end of the introductory chapter, you should describe the structure of the thesis. It is useful to explain the main content of each chapter. You should reference each chapter. Make sure you always state the type of reference. For example: Chapter 2 explains how to summarise the state of the art in a clear and structured way. Where appropriate, particularly relevant sub-chapters may also be referenced. Make sure that the term „sections“ is used from the subchapter level onwards. The term „subsection“ should not be used as this would disrupt the flow of the text.

Chapter 2

State of the art

If necessary, a more detailed classification of the thesis in the context of current research can be made here. This is particularly necessary for Master's theses. A clear distinction is usually made between the thesis and existing research and developments in related research areas. For the sake of clarity, it is often useful to prepare a table summarising the research results described in this section. This can be used to summarise the main content and findings of previous research.

Digital twin became a novice but though every popular methodology, due to its advantages. As a novel methodology which may significantly impact on the medicine lot of large companies started to work on their own platforms. Planning future surgeries, simulation of the functionalities, induce personalized treatment through artificial models, simulating variety of diseases to develop new approaches in treatment and response of organs on it. Complexity of such system lead to division into as layers so architectures. Some companies concentrated their efforts on small critical parts as for example till for the entire patient models with integrated EHR, genomics and imaging, and DigiTwins (EU Horizon 2020 project) oriented on predicting health outcomes and guiding personalized medicine.

- Simulated distinctive Organs Philips Digital Twin for Cardiology or Siemens Healthineers - Digital Twin of the heart, Dassault Systemes - Libig Heart and Living Lung Project - Body-level Systems Siemens Healthineers and IBM Watson Health - Disease specific Platforms Nvidia Clara project for the cancer genome analysis - Surgery and rehabilitation Twins intuitive Surgical (Da Vinci), Rehabilitation

twin to simulate musculoskeletal functions. - Infrastructure and Device-level Twins
GE Healthcare and Medtronic - medical devices, ICU Bed Digital Twin

2.1 Citation

Important in this and all subsequent chapters: **Cite your sources!!!** Whenever something is taken literally or analogously from a book, a publication, a lecture or a website, this **must** be indicated by stating the source in the text (e.g., **Lenze_Einfuehrung_2000**) and the complete source in the bibliography! It is absolutely not permitted to copy longer passages **verbatim, almost verbatim or analogously** from another document without citing this precisely, even if the reference is given in the bibliography (plagiarism, failed, no repetition possible). As part of the declaration at the end of the Bachelor's/Master's thesis, the student pledges to have complied with this fundamental obligation in the context of academic work, to have cited all sources and to have indicated quotations. **Bloch2023PreprintResolver, Bloch2023PreprintResolvera**

Remember that if you do not cite correctly, you are responsible for other people's (possibly incorrect) statements. If you cite the basis on which you have made your statements, you show that you have worked to the best of your knowledge. On the other hand, if you do not cite other people's statements and pass them off as your own, you may be held responsible for other people's mistakes.

Also remember that citations help you. In science, claims are usually supported by experiments or studies. You can therefore avoid doing your own research by building on the results of other scientists. You should thank the authors by citing them.

If there is a prevalence of correctly quoted, but more or less literally copied passages in a paper, this is not plagiarism in the strict sense, but it is also not proof of independent scientific and practical work as required by the examination regulations (failed, retake possible).

Sources can be cited in the document as a reference **Article** or as a footnote¹.

¹**Article**

It is only important that one of the two types is used consistently throughout the document.

This is a citation with two authors **Chui_Approximation_1992** and this with more than two authors **Leshno_Multilayer_1993**.

Remember that when citing book sources, a page number must always be given.

2.1.1 Literal quotations

If a passage is taken verbatim from another source, it must be placed in quotation marks and accompanied by precise details of the source, including page references. It is also a good idea to italicise the quoted passage to make it stand out from your own statements. Here's an example: „It's like this: at the start of the project, you know very little about the development effort and time required. As the project progresses, however, the degree of accuracy increases until you know everything at the end of the project, because then everything has happened.“**kupper1986kunst**

Chapter 3

Methods

In this section, describe relevant techniques or methods. Focus on essential basics that will help the reader understand your working method, design choices, or implementation de-scribed later.

3.1 Formulas

These sections deal with the basics of the problem to be solved. Formulas can be used here. Example of a formula:

$$a^2 + b^2 = c^2 \tag{3.1}$$

shows the relationship between the side lengths of a right triangle. Again, remember to speci-fy the type of reference (in this case, Formula). The first reference should be as close as pos-sible to the formula being used. Also, the order of the formulas should be maintained for the reference. If possible, do not reference Formula 5 before referencing Formula 4. You should also explain any variables used in the formula. Example: In Formula 3.1 the variables a and b die Seitenlänge der beiden Katheten dar. represent the side lengths of the two legs. The variable c is the length of the hypotenuse

3.2 Figures

Figures (see Figure 3.1) can also be useful and can be integrated as well. They are used to visually illustrate process-es, results, or procedures. Overall, make sure to include them in high quality (for print quality \geq DPI if possible). Avoid using the jpg format except for photos, as artifacts can occur. For graphs and other figures that may contain text, use vector formats (svg, pdf, emf, ...) if possible. Scale the width and height of images equally, otherwise distortion will occur. For color images, check that they are still visible on a black-and-white printer. Make sure that the same types of figures (e.g. box plots, scatter plots, bar charts, ...) are displayed as uniformly as possible. If possible, use colors only to support information, and use legends to clarify the meaning of colors. Also, use meaningful axis labels, including units. For accessibility reasons, do not use red-green or white labels in colored boxes.

Each embedded figure also requires a caption (**below** the figure), which must be meaningful and self-explanatory. The reader should be able to extract all the information from the image and the caption in order to understand it. Each caption should end with a full stop.

If you have taken the image from an external source, you must also state this in the caption (e.g. [Image source: [Quelle: **Lenze_Note_1994**]) This also applies if you have modified the original graphic or copied it from another source ([e.g. figure based on **DeVore_Optimal_1989**]). The source must be included in the bibliography.

If you use an online source, you must include the URL and the date of access (e.g. [source: <https://www.fh-dortmund.de>, last accessed: 2024-04-17]).

In addition, each image must be referenced in the text, otherwise it is superfluous. The text should begin with a brief description of each image (What can you see in the image?), followed by an explanation and interpretation (What do you deduce from the image?). The images should be close to the first reference in the text and embedded in the text in the order of their reference.

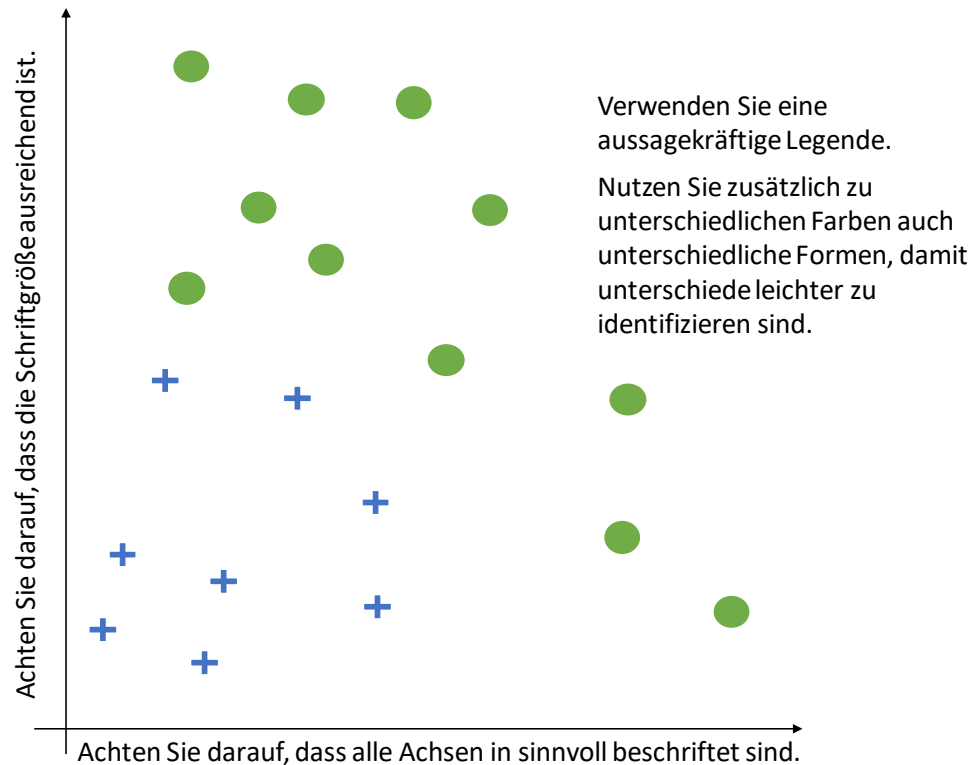


Figure 3.1: Dies ist ein Beispielbild [Quelle: Eigene Erstellung].

3.3 Algorithms and Pseudocode

It can be useful to use pseudocode to explain algorithms. An example of this Pseudocode 3.3.1, where you should also choose a meaningful caption and reference the source code in the text.

3.4 Tables

Some facts can be nicely summarised in a table. Make sure that tables are clear and do not exceed the page margins. Unlike figures, each table needs a heading **above** the table. This must also be meaningful and give all the information needed to understand the table. Each table must be referenced in the text in the order in which it appears. Example: Table 3.1. Make sure that the formatting of the table is consistent. For columns containing only numerical values, right-justification is recommended. Also ensure a consistent number of decimal places (e.g. 3).

Require: $n \geq 0 \vee x \neq 0$
Ensure: $y = x^n$
1: $y \Leftarrow 1$
2: **if** $n < 0$ **then**
3: $X \Leftarrow 1/x$
4: $N \Leftarrow -n$
5: **else**
6: $X \Leftarrow x$
7: $N \Leftarrow n$
8: **end if**
9: **while** $N \neq 0$ **do**
10: **if** N ist gerade **then**
11: $X \Leftarrow X \times X$
12: $N \Leftarrow N/2$
13: **else**
14: $y \Leftarrow y \times X$
15: $N \Leftarrow N - 1$
16: **end if**
17: **end while**

Pseudocode 3.3.1: Calculate $y = x^n$.

Table 3.1: This is a meaningful table heading

Name of Model	Hyper parameters	Accuracy (in %)
Modell A	$\alpha = 0.010$	77.010
Modell B	$\alpha = 0.001$	80.310
Modell C	$\alpha = 0.100$	71.050
Modell D	$\alpha = 0.050$	12.010
Modell E	$\alpha = 0.010$	60.010

Chapter 4

Design

This chapter analyzes and presents the design of the software in detail. Describe important decisions made during the design phase and give reasons for them. What requirements were identified? What requirements were rejected?

4.1 Design details

Classic approach to the design and development of a software application (OOA, OOD, OOP, etc.). In particular, the corresponding diagrams should be included here (or – if too extensive – in the appendix at the latest).

Chapter 5

Implementation

This chapter describes the implementation. Focus on describing and explaining important details and implementation choices.

5.1 Software Bill of Material

The Software Bill of Materials is a list of the software used for the implementation and its licenses. An example is shown in Table 5.1.

Table 5.1: Software used.

Name	License	Purpose	Version	URL ¹
Java	GNU GPL	Programming language	17.0.1	https://www.oracle.com/java/
Apache Tika	Apache 2.0	Java Toolkit	2.6.0	https://tika.apache.org/
Spring Framework	Apache 2.0	Java Framework	2021.0.5	https://spring.io
...				
iText	AGPL 3.0	Java toolkit for editing PDF documents	7.2.4	https://itextpdf.com/

¹ last access: 2023-02-20

5.2 The choice of programming language

Short justification for the choice of programming language. Which development tool did you use and why? Or did you work directly with the JDK? If so, why? No detailed introduction to Java; this is now standard. However: New and special libraries, packages or classes used must be justified and explained. Currently the amount of new languages so as old enhanced are overwhelming. As in this application will be used 2 parts, it was decided to use for backend: python and java.frontend python TK framework and vue.js. Although current situation in programming languages area is very dynamic: some languages quite fast become obsolete, some revive from the post, some environmental requirements limited the selection of them. Thus, as a frontend to the TK python framework. TK framework is one threaded simple framework, oriented onto fast modeling of an application using python programming language. This framework has a set of GUI elements, which mostly are enough to build user-friendly GUI. As in the app it is used machine learning python was chosen as a perfect tool for that, making development of the part of application easier, faster and more comfortable. For the backend it was used spring boot. Object oriented language make it better to create applications with complex data structure. frontend for the admin site was selected vue.js. This is a modern framework making UI flexible, scalable and user friendly. As a student of FH Dortmund it was clearly selected JetBrains PyCharm and JetBrains IntelliJ Idea. These IDEs are used on all levels of development - from students till professionals, because of wide programming features. The used license is from FH Dortmund, what makes it free for students. Libraries which were used are: o3d. It is open source library.

5.3 Specific implementation details

Selected parts of the source code that are essential for the functionality of the program should be explained in detail here. In addition to demonstrating the general concepts for implementing the mathematical computation in program code, this section also deals with issues such as efficiency, parallelizability, numerical stabil-

ity, etc. Problems with the implementation and their solutions can also be explained in this chapter.

Chapter 6

Evaluation

The evaluation is usually the main part of your work when writing a machine learning thesis. Show that you have learned how to perform systematic experiments. The chapter contains the results of the developed tool or workflow.

Chapter 7

Summary and Outlook

Once again, it is briefly explained what was actually done in the thesis. The author also states what he or she thinks could have been done differently. This allows you to show that you have looked beyond the scope of the actual problem. A total of 1-2 pages should be sufficient. At the end of this chapter, the bachelor/master thesis should be about 40/80 pages long! Of course, this is only a rough guide, but it should be kept in mind! Better a good 40 pages than a redundant and boring 60 pages.

Appendix A

Diagrams and Tables

One or more appendices can, but do not have to be present. As a rule of thumb, anything that disturbs the flow of reading can be included in an appendix, in particular source code listings (longer than one page), extensive tabular material, etc. The original source code of the programs must also be submitted on a digital storage medium. Executable machine code for various platforms may also be included. The medium should always include a README text file describing exactly how to run the program.

Unlike normal chapters, appendices are not numbered 1, 2, 3, ..., but A, B, C, If there is only one appendix, the numbering A can be omitted.

At the end of the appendix, the length of the Bachelor's/Master's thesis should be about 60/100 pages!

Appendix B

UML diagrams

This is where class diagrams and UML diagrams could be placed

Bibliography

Declaration of Independence

I hereby declare that I have written this thesis independently and have not used any outside help or sources other than those indicated. All passages taken literally or by analogy from published or unpublished writings and other sources have been marked as such. This thesis has not previously been submitted in the same or similar form to any examination authority.

Explanation of Tools Used

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2. Use of an external (commercial) proofreading service: Yes No
if so, which
3. 3) The following persons have additionally proofread the thesis:
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5. Use of language translation tools (e.g., Google Translator, DeepL), Yes No
if so, which ones and in which sections:
6. Use of language correction software (e.g., Grammarly), Yes No
if so, which ones and in which sections:
7. Use of other tools:

I acknowledge that my thesis may be checked using plagiarism detection software.
I confirm that the above statements have been completed in full and to the best of my knowledge.

Dortmund, July 13, 2025

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