

# LEIBNIZ UNIVERSITÄT HANNOVER

Faculty of Electrical Engineering and Computer Science  
Human-Computer Interaction Group

## CASUAL INTERACTION WITH A SMARTWATCH

A Thesis presented for the degree of Master of Science

by  
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## EIDESSTATTLICHE ERKLÄRUNG

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Hiermit versichere ich, die vorliegende Arbeit ohne Hilfe Dritter und nur mit den angegebenen Quellen und Hilfsmitteln angefertigt zu haben. Alle Stellen, die wörtlich oder inhaltlich aus den Quellen entnommen wurden, sind als solche kenntlich gemacht worden. Diese Arbeit hat in gleicher oder ähnlicher Form noch keiner Prüfungsbehörde vorgelegen.

*Hannover, July 2016*

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Sven Röttering



## ABSTRACT

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This thesis investigates which and how user interfaces allowing for *Casual Interaction* should be implemented. A mobile music player as a representative application is implemented on an android handheld device, which is fully controllable by an android smartwatch. Interactions between user and music player can happen via touch input, speech commands or arm gestures. Subsequently a case study investigates which interaction techniques are preferred by users depending on task and context. For this purpose the participants are put in 6 different scenarios in which they have to follow predefined actions regarding the music player.

## ZUSAMMENFASSUNG

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Diese Arbeit untersucht welche und auf welche Weise Nutzerschnittstellen, die *Casual Interaction* nutzen, implementiert werden sollten. Als Beispielanwendung wird ein mobiler Musikplayer auf einem Android Smartphone implementiert, der vollständig per Android Smartwatch gesteuert werden kann. Touch-Eingabe, Sprachbefehle und Armgesten stehen dem Benutzer dabei als Interaktionsmöglichkeiten zur Verfügung. In einer Studie wird anschließend untersucht, welche Interaktionsmöglichkeiten, abhängig von Aufgabe und Kontext, von den Benutzern bevorzugt werden. Dazu werden die Teilnehmer in 6 verschiedene alltägliche Situationen versetzt, in denen sie Vorgaben erhalten, welche Funktionen des Musikplayer sie steuern sollen.



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## MOTIVATION

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Electronic devices connected to the internet play a big role in almost everyone's life. According to a survey<sup>1</sup> two thirds of the global population have access to the internet and almost every third human owns a smartphone in 2016. People not being bound to stationary computers anymore has numerous advantages and opens up for manifold possibilities of applications. However most applications are exclusively touch based and hence draw a user's attention from her environment to the screen in a large extent. Depending on the context, this inobservance causes various levels of adverse impact – one merely could have to reread a passage of a book or in fact cause a serious car accident with lethal consequences. Furthermore, a user is not always able to interact with a handheld device as intended due to physical or mental barriers.

*Casual Interaction* addresses this issue by introducing additional input techniques and interactions which offer the required flexibility in terms of control over an application, such that the user can limit the required amount of focus to a minimum [8]. The H-metaphor [6] expresses this by looking at a horse rider. Whenever high amount of control is needed, the rider can steer the horse precisely with the reins. However, riding straightly requires nearly no effort from the rider.

The music player implemented in this thesis offers a speech and armgesture interface for input in addition to the typical touch based user interface. This enables the user to leave her handheld device in the pocket and interact with it even when her hands are not available. A typical daily life scenario involving the music player might be the following:

Programmer Bob is a passionate music listener. At work he starts the day with his favorite playlist with shuffle mode enabled to boost his coding efficiency. Occasionally some songs hit his ears that he heard enough of in the last days so he performs a short arm swing to the right to skip to the next song without losing track of his current programming task.

After work he rides his bike home, still listening to music, to have a physical compensation for sitting in a chair half the day. In order to hear other traffic partici-

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<sup>1</sup> <http://www.pewglobal.org/2016/02/22/smartphone-ownership-and-internet-usage-continues-to-climb-in-emerging-economies/>

pants and emergency sirens he decides to turn the volume of the music down a bit by raising his smartwatch to his mouth and saying “*volume down, please*”. Arriving at home he switches from listening with headphones to his brand new sound system that is spread around his entire house. During dinner preparations he gets a phone call from a friend. His phone resides on the table, however Bob’s hands are still dirty from cooking so he tells his watch to pause the music and answer the call. They arrange on having dinner together today at Bob’s place. It strikes Bob that his music library is not prepared for such a dinner but he is able to delegate the creation of a playlist to his music player by simply specifying suitable audio features. Not having to bother about finding the right music enables Bob to finish cooking just before his guest arrives.

This fictive scenario reveals the necessity of alternative input techniques to perform casual interactions in situations where users are physically or mentally obstructed. In order to decide which additional input techniques an application should provide and how the corresponding user interfaces should be designed one has to consider the possibilities these techniques offer as well as how users approach them. The last aspect particularly depends on the user’s preferences and perception performing the interactions. On the one hand, the perceived amount of control for a particular level of engagement is important. *Is she able to achieve the desired reaction of the application or does it feel like the application has developed it’s own life?*

On the other hand, users often times get influenced by how interactions appear to the environment. *Can i perform an arm gesture right now or will people stare at me if i suddenly wave my arm through the air?* These and related concerns need to be kept in mind in order to be able to develop useful and effective casual user interfaces.

However, devices require certain hardware features to enable such interactions in the first place. First, it should stay where it is needed without encumbering the user. Typical remotes or smartphones occupy at least one hand for every interaction they offer. Since this is not beneficial a wearable device is needed that is attached to the body without obstructing everyday activities. Second, the device should offer touch-free interaction. This can be realised by adding movement sensors (e.g. accelerometer or gyroscope) and a microphone.[4]

This thesis builds on the previous work of Karoline Busse [4] who developed a wrist-worn silicone bracelet intended for usage with lighting systems. The bracelet is missing on some important components, though, to gain more potential, namely a microphone and a display. Smartwatches basically offer the most important hardware

components needed for creating a comfortable and enjoyable casual interaction experience thus being a perfect device for the further studies of this thesis.

A music player is chosen as a representative everyday application. The music player is connected to a private Spotify account via the Spotify Android Software Development Kit (SDK) <sup>2</sup> which serves the music library. Touch, speech and arm gesture input for player control realize different levels of engagement.

Chapter 2 first outlines the related work. Chapter 3 then gives an insight into the implementation of the music player's core features. Subsequently the user study design is addressed in chapter ?? and the resultant data is evaluated in chapter ??.

Finally, chapter ?? discusses the findings, draws a conclusion and provides ideas for future improvements to casual interactions.

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<sup>2</sup> <https://developer.spotify.com/technologies/spotify-android-sdk/>



## RELATED WORK

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Casual interaction has become a big research topic in human-computer interaction (HCI) nowadays.

Pohl and Murray-Smith [8] have characterised the term casual interaction in contrast to focused interaction and described the *focused-casual continuum*, which is a control-theoretic framework that characterizes input techniques in regard to how much flexibility, in terms of thinking and effort, they allow a user to invest into interactions. They showed in a user study that users adjust their level of engagement to the task's complexity.

On this basis, [4] constructed a wrist worn silicone bracelet. When worn, a user could casually interact with a light source. Simple actions like turning the light on and off up to picking individual colors with a capacitive touch stripe. Accelerometer based gestures could be used to activate previously defined and memorized light settings. Despite being highly accessible on the wrist, a user would still have to utilize the hand without the bracelet to activate it's features making interactions rather impractical in certain situations.

Another approach places a depth camera for capturing hand gestures on the user's foot pointing upwards [1]. This allows for discreet interactions thus neglecting concerns of social acceptability of performing gestures as they found out. In a lab study they compared physical and mental demand, user preferences and demonstrated a 94-99% recognition rate.

An alternative input technique is shown in [9]. They introduce around-device devices. Input is received by observing position and rotation as well as arrangement or absence of the around-device devices. To capture this information they propose placing a smartphone equipped with a depth camera nearby. In contrast to the aforementioned approaches, this technique is limited to stationary contexts automatically excluding any in-motion-situations.

Furthermore, casual interaction was applied to mobile music retrieval by [3]. They investigated the listening habits of 95 last.fm<sup>1</sup> users and divided them into three groups. The first group consists of the engaged listeners who invest high initial engagement by e.g. selecting a specific album and afterwards only make quick and decisive interventions. The second group consists of the casual users who invest little effort in interventions at any time. The third group is a mixture of the first two groups where music listening behaviour highly depends on the context. Based on these groups they added a seman-

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<sup>1</sup> Internet radio station: [www.last.fm](http://www.last.fm)

tic zooming view of linear music space to a already given music retrieval interface. Zooming in on the view enables the user to make more specific music selections. A recommender system additionally infers other relevant music depending on the input specificity.

In the scope of interactions with smart home appliances [7] conducted a series of user study on gestural input for devices found in an average living room – namely blinds, lamps, tv, Electronic Program Guide (EPG), video recorder and answering machine. In the first study they tried to determine a gesture vocabulary. Therefore they observed eighteen participants seated on a sofa in fully functional living room with the above mentioned devices. The participants were asked to perform a gesture, they would deem appropriate, for every action or referent as [10] refer to. In a second study 22 new participants should then map the gestures from the vocabulary back to the referents. The last study was performed by 10 participants to study the memorability. In a training session every participant performed every gesture five times and then rated the suitability. Finally a slide show displayed every referent for 5 seconds in a random order. If the participant could not perform the gesture in this time, the correct gesture was shown again and the referent was added to the end of the slide show again. Overall their results showed, that simple and short physically or symbolic inspired gestures were rated most suitable and appeared to be most memorable.

In Addition, [5] conducted two related user studies. 28 participants were asked to propose gestures for referents similar to the above mentioned. A month later, the same participants had to choose the most suitable gesture for each gesture group (i.e. for each referent) which also included their own derived gesture. It turned out, that 65% of the top gestures from the first experiment were not the most chosen gestures in the second experiment. For some of the most agreed gestures in the second experiment, e.g. rubbing one's shoulders for turning off air conditioning, the frequency was only below 10% in the first experiment. Their results show that considering only the most frequent matching user derived gestures can not automatically be considered to be most suitable.

Casual interaction through speech input is yet to be explored. Some research, however, was inquired in the field of smart homes. For example, [2] prototyped a cooking assistant that was installed in their Ambient Living Testbed. Users could interact with the assistant either via touchscreen, mouse and keyboard or via speech input. The latter came in handy while being physically distracted as they were searching for ingredients or cutting vegetables. The findings from the user study based on the cooking assistant revealed that users prefer the availability of multiple modalities as the possibility to fall back to touch or mouse input provides an idea safety against failures of the voice recognition. Furthermore, they state a higher acceptance

of command-based speech interactions instead of entering whole sentences, as short commands are easier to learn. For more complex commands, users tend to ask the system for help.





IMPLEMENTATION

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- Intro text describing what is implemented, features, hardware
- Show user interface and describe mechanics. how to speech and gesture. mention activation angle study and show plot.
- Mention Modules and communicationManager. show communication protocol. maybe uml diagram of whole application
- Describe Handheld module. introduce spotify api + webapi wrapper.
- Describe Wear module
- possible improvements and restrictions to the program (like leaving out unneeded spotify features), input feedback

This chapter describes the smartwatch controlled mobile music player implementation. It gives an insight into the chosen interaction techniques, the mobile-wear communication and the core music player functions.

The essential music library is provided by a private Spotify<sup>1</sup> premium account. The prototype is divided into two separate applications, i.e. mobile (handheld) and wear (smartwatch). Users are able to access all features of the mobile application via the smartwatch application. In order to make use of the focused-casual continuum [8], three interaction techniques, differing in the amount of control granted, are available for the user:

- Touch
- Speech
- Gesture

Each technique can be used for the simpler actions of the music player such as play and pause, skip to previous or next song and changing the volume. However, for the more complex interactions, e.g. choosing a playlist, only the touch and speech interaction methods suffice. Gesture and speech input can be performed casually while not even looking at the device (the smartwatch). The following section describes the functionality and the power of the different methods.

Both applications are implemented for the android platform. The handheld device has no further hardware or software requirements

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<sup>1</sup> Music streaming service: [www.spotify.com](http://www.spotify.com)

other than supporting the android wearable Application Programming Interface (API) so a Samsung Galaxy S6 is chosen. The smart-watch application certainly requires the device to be equipped with an acceleration sensor and a microphone. A moto360 from Motorola is well suited for this. Both devices need to support Bluetooth, too.

### 3.1 USER INTERFACE

The GUI from the mobile application only differs in appearance from the wear GUI. In terms of control over the music player, both versions offer the same possibilities and show the same information at any given time. The wear application, however, additionally introduces speech and gesture interactions which the mobile application is not capable of.

#### 3.1.1 *Touch Input - GUI*

Both GUIs are designed to be simple and straightforward. The mobile version mainly consists of two areas. Figure 1 depicts a screenshot of this layout. A control panel is situated at the bottom of the screen. Above this is a left-right scrollable pager containing different kinds of lists. The scrollable list pager contains five lists, one for each music arrangement which are playlists, songs, albums, artists and categories.

*Categories are  
Spotify's extended  
version of genres*

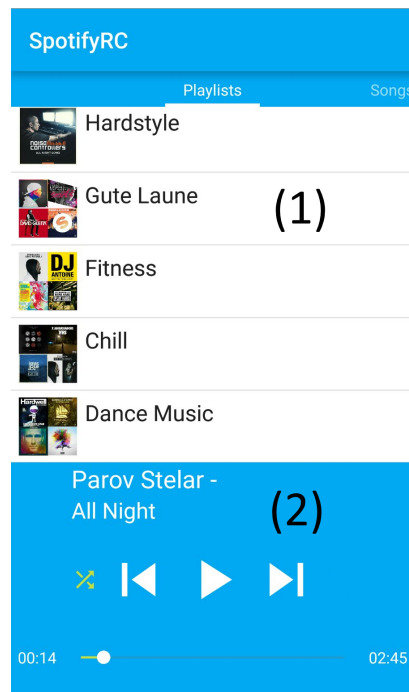


Figure 1: GUI of the mobile application. (1) shows the left-right scrollable list pager with indicators which list is shown at the top. (2) shows the player control panel in blue.

The control panel located beneath the list pager contains four control buttons such as a shuffle button including on-off indicator, a skip to previous song button, a play-pause button and a skip to next button. Information on the name of the current song and artist can be found above these buttons. The track's progress and total duration can be found at the very bottom of the screen.

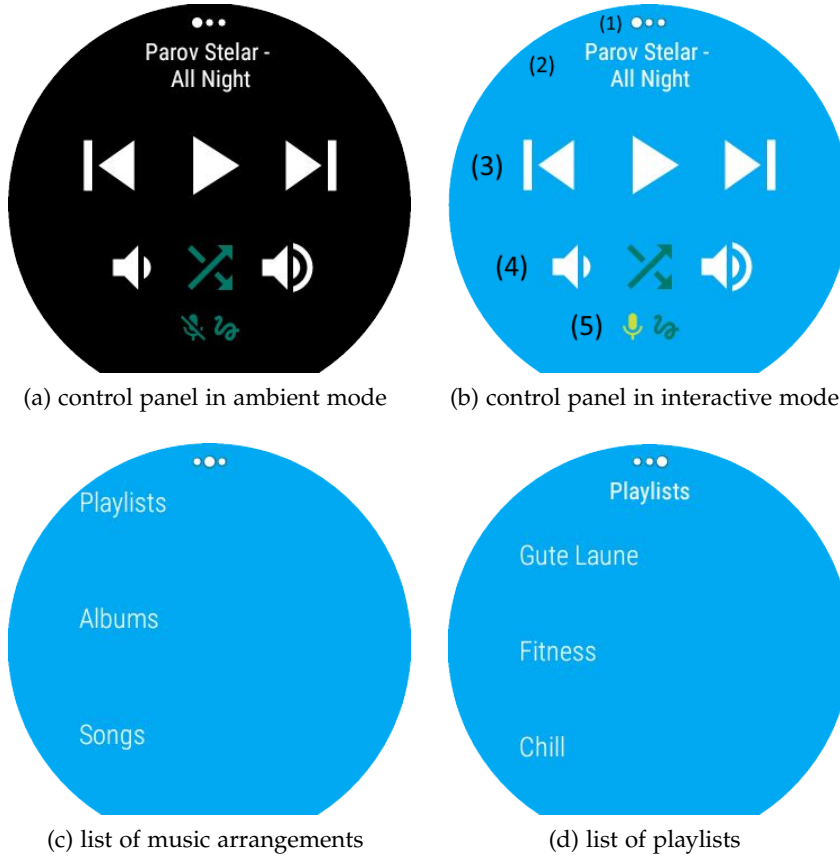


Figure 2: The GUI of the wear application consists of a GridViewPager containing three horizontal pages. A dot indicator at the top of the screen shows the current page. 2a depicts the controls page in ambient mode, i.e. battery saving mode, while 2b is the same screen in interactive mode. Swiping right brings up the list of music arrangements 2c. Selecting e.g. playlists switches to the third page 2d showing a list with all playlists.

### 3.1.2 Speech Control

### 3.1.3 Gesture Control



INTRODUCTION

---

This bundle for L<sup>A</sup>T<sub>E</sub>X has two goals:

1. Provide students with an easy-to-use template for their Master's or PhD thesis. (Though it might also be used by other types of authors for reports, books, etc.)
2. Provide a classic, high-quality typographic style that is inspired by ?'s "*The Elements of Typographic Style*" [? ].

The bundle is configured to run with a *full* MiK<sub>T</sub>E<sub>X</sub> or T<sub>E</sub>XLive<sup>1</sup> installation right away and, therefore, it uses only freely available fonts. (Minion fans can easily adjust the style to their needs.)

People interested only in the nice style and not the whole bundle can now use the style stand-alone via the file `classicthesis.sty`. This works now also with "plain" L<sup>A</sup>T<sub>E</sub>X.

As of version 3.0, `classicthesis` can also be easily used with L<sub>Y</sub>X<sup>2</sup> thanks to Nicholas Mariette and Ivo Pletikosić. The L<sub>Y</sub>X version of this manual will contain more information on the details.

This should enable anyone with a basic knowledge of L<sup>A</sup>T<sub>E</sub>X 2<sub>ε</sub> or L<sub>Y</sub>X to produce beautiful documents without too much effort. In the end, this is my overall goal: more beautiful documents, especially theses, as I am tired of seeing so many ugly ones.

The whole template and the used style is released under the GNU General Public License.

If you like the style then I would appreciate a postcard:

André Miede  
Detmolder Straße 32  
31737 Rinteln  
Germany

The postcards I received so far are available at:

<http://postcards.miede.de>

So far, many theses, some books, and several other publications have been typeset successfully with it. If you are interested in some typographic details behind it, enjoy Robert Bringhurst's wonderful book.

*Casual Interaction  
with a Smartwatch  
1.0*

*A well-balanced line  
width improves the  
legibility of the text.  
That's what  
typography is all  
about, right?*

---

<sup>1</sup> See the file `LISTOFFILES` for needed packages. Furthermore, `classicthesis` works with most other distributions and, thus, with most systems L<sup>A</sup>T<sub>E</sub>X is available for.

<sup>2</sup> <http://www.lyx.org>

**IMPORTANT NOTE:** Some things of this style might look unusual at first glance, many people feel so in the beginning. However, all things are intentionally designed to be as they are, especially these:

- No bold fonts are used. Italics or spaced small caps do the job quite well.
- The size of the text body is intentionally shaped like it is. It supports both legibility and allows a reasonable amount of information to be on a page. And, no: the lines are not too short.
- The tables intentionally do not use vertical or double rules. See the documentation for the `booktabs` package for a nice discussion of this topic.<sup>3</sup>
- And last but not least, to provide the reader with a way easier access to page numbers in the table of contents, the page numbers are right behind the titles. Yes, they are *not* neatly aligned at the right side and they are *not* connected with dots that help the eye to bridge a distance that is not necessary. If you are still not convinced: is your reader interested in the page number or does she want to sum the numbers up?

Therefore, please do not break the beauty of the style by changing these things unless you really know what you are doing! Please.

#### 4.1 ORGANIZATION

A very important factor for successful thesis writing is the organization of the material. This template suggests a structure as the following:

*You can use these  
margins for  
summaries of the  
text body...*

- `Chapters/` is where all the “real” content goes in separate files such as `Chapter01.tex` etc.
- `FrontBackMatter/` is where all the stuff goes that surrounds the “real” content, such as the acknowledgments, dedication, etc.
- `gfx/` is where you put all the graphics you use in the thesis. Maybe they should be organized into subfolders depending on the chapter they are used in, if you have a lot of graphics.
- `Bibliography.bib`: the Bib<sub>TEX</sub> database to organize all the references you might want to cite.
- `classicthesis.sty`: the style definition to get this awesome look and feel. Does not only work with this thesis template but also on its own (see folder `Examples`). Bonus: works with both `LATEX` and `pdfLATEX`... and `LyX`.

<sup>3</sup> To be found online at  
<http://www.ctan.org/tex-archive/macros/latex/contrib/booktabs/>.

- `ClassicThesis.tcp` a  $\text{\TeX}$ nicCenter project file. Great tool and it's free!
- `ClassicThesis.tex`: the main file of your thesis where all gets bundled together.
- `classicthesis-config.tex`: a central place to load all nifty packages that are used. In there, you can also activate backrefs in order to have information in the bibliography about where a source was cited in the text (i. e., the page number).

*Make your changes and adjustments here.* This means that you specify here the options you want to load `classicthesis.sty` with. You also adjust the title of your thesis, your name, and all similar information here. Refer to Section 4.3 for more information.

This had to change as of version 3.0 in order to enable an easy transition from the “basic” style to  $\text{\LaTeX}$ .

In total, this should get you started in no time.

## 4.2 STYLE OPTIONS

There are a couple of options for `classicthesis.sty` that allow for a bit of freedom concerning the layout:

- General:
  - `drafting`: prints the date and time at the bottom of each page, so you always know which version you are dealing with. Might come in handy not to give your Prof. that old draft.
- Parts and Chapters:
  - `parts`: if you use Part divisions for your document, you should choose this option. (Cannot be used together with `nochapters`.)
  - `nochapters`: allows to use the look-and-feel with classes that do not use chapters, e. g., for articles. Automatically turns off a couple of other options: `eulerchapternumbers`, `linedheaders`, `listsseparated`, and `parts`.
  - `linedheaders`: changes the look of the chapter headings a bit by adding a horizontal line above the chapter title. The chapter number will also be moved to the top of the page, above the chapter title.
- Typography:
  - `eulerchapternumbers`: use figures from Hermann Zapf's Euler math font for the chapter numbers. By default, old style figures from the Palatino font are used.

*...or your supervisor might use the margins for some comments of her own while reading.*

- `beramono`: loads Bera Mono as typewriter font. (Default setting is using the standard CM typewriter font.)
  - `eulermath`: loads the awesome Euler fonts for math. (Palatino is used as default font.)
  - `pdfspacing`: makes use of `pdftex`' letter spacing capabilities via the `microtype` package.<sup>4</sup> This fixes some serious issues regarding math formulæ etc. (e. g., “ß”) in headers.
  - `minionprospacing`: uses the internal `textssc` command of the `MinionPro` package for letter spacing. This automatically enables the `minionpro` option and overrides the `pdfspacing` option.
- Table of Contents:
    - `tocaligned`: aligns the whole table of contents on the left side. Some people like that, some don't.
    - `dottedtoc`: sets `pagenumbers` flushed right in the table of contents.
    - `manychapters`: if you need more than nine chapters for your document, you might not be happy with the spacing between the chapter number and the chapter title in the Table of Contents. This option allows for additional space in this context. However, it does not look as “perfect” if you use `\parts` for structuring your document.
  - Floats:
    - `listings`: loads the `listings` package (if not already done) and configures the List of Listings accordingly.
    - `floatperchapter`: activates numbering per chapter for all floats such as figures, tables, and listings (if used).
    - `subfigure`: is passed to the `tocloft` package to enable compatibility with the `subfigure` package. Use this option if you want use `classicthesis` with the `subfigure` package.

The best way to figure these options out is to try the different possibilities and see, what you and your supervisor like best.

In order to make things easier in general, `classicthesis-config.tex` contains some useful commands that might help you.

### 4.3 CUSTOMIZATION

This section will give you some hints about how to adapt `classicthesis` to your needs.

---

<sup>4</sup> Use `microtype`'s `DVIoutput` option to generate DVI with `pdftex`.



The file `classicthesis.sty` contains the core functionality of the style and in most cases will be left intact, whereas the file `classicthesis-config.tex` is used for some common user customizations.

The first customization you are about to make is to alter the document title, author name, and other thesis details. In order to do this, replace the data in the following lines of `classicthesis-config.tex`:

*Modifications in  
classic-  
thesis-config.tex*

```
% *****
% 2. Personal data and user ad-hoc commands
% *****
\newcommand{\myTitle}{A Classic Thesis Style\xspace}
\newcommand{\mySubtitle}{An Homage to...\xspace}
```

Further customization can be made in `classicthesis-config.tex` by choosing the options to `classicthesis.sty` (see Section 4.2) in a line that looks like this:

```
\PassOptionsToPackage{eulerchapternumbers,drafting,listings,
  subfig,eulermath,parts}{classicthesis}
```

If you want to use backreferences from your citations to the pages they were cited on, change the following line from:

```
\setboolean{enable-backrefs}{false} % true false
```

to

```
\setboolean{enable-backrefs}{true} % true false
```

Many other customizations in `classicthesis-config.tex` are possible, but you should be careful making changes there, since some changes could cause errors.

Finally, changes can be made in the file `classicthesis.sty`, although this is mostly not designed for user customization. The main change that might be made here is the text-block size, for example, to get longer lines of text.

*Modifications in  
classicthesis.sty*

## 4.4 ISSUES

This section will list some information about problems using `classicthesis` in general or using it with other packages.

Beta versions of `classicthesis` can be found at the following Google code repository:

<http://code.google.com/p/classicthesis/>

There, you can also post serious bugs and problems you encounter.

### *Compatibility with the glossaries Package*

If you want to use the `glossaries` package, take care of loading it with the following options:

```
\usepackage[style=long,nolist]{glossaries}
```

Thanks to Sven Staehs for this information.

### *Compatibility with the (Spanish) babel Package*

Spanish languages need an extra option in order to work with this template:

```
\usepackage[spanish,es-lcroman]{babel}
```

Thanks to an unknown person for this information (via Google Code issue reporting).

FURTHER INFORMATION FOR USING `classicthesis` WITH SPANISH (IN ADDITION TO THE ABOVE) In the file `ClassicThesis.tex` activate the language:

```
\selectlanguage{spanish}
```

In order to get the bibliography style right, you can use the following:

```
\bibliographystyle{babplain}
```

For this, it is necessary to load the package:

```
\usepackage[spanish,fixlanguage]{babelbib}
\selectbiblanguage{spanish}
```

If there are issues changing `\tablename`, e. g., using this:

```
\renewcommand{\bibname}{Referencias}
\renewcommand{\tablename}{Tabla}
```

This can be solved by passing `es-tabla` parameter to `babel`:

```
\PassOptionsToPackage{es-tabla,spanish,es-lcroman,english}{babel}
\usepackage{babel}
```

But it is also necessary set `spanish` in the `\documentclass`.

Thanks to Alvaro Jaramillo Duque for this information.

### *Compatibility with the pdfsync Package*

Using the `pdfsync` package leads to linebreaking problems with the `graffito` command. Thanks to Henrik Schumacher for this information.

## 4.5 FUTURE WORK

So far, this is a quite stable version that served a couple of people well during their thesis time. However, some things are still not as they should be. Proper documentation in the standard format is still missing. In the long run, the style should probably be published separately, with the template bundle being only an application of the style. Alas, there is no time for that at the moment. . . it could be a nice task for a small group of L<sup>A</sup>T<sub>E</sub>Xnicians.

Please do not send me email with questions concerning L<sup>A</sup>T<sub>E</sub>X or the template, as I do not have time for an answer. But if you have comments, suggestions, or improvements for the style or the template in general, do not hesitate to write them on that postcard of yours.

## 4.6 BEYOND A THESIS

It is easy to use the layout of `classicthesis.sty` without the framework of this bundle. To make it even easier, this section offers some plug-and-play-examples.

The L<sup>A</sup>T<sub>E</sub>X-sources of these examples can be found in the folder with the name Examples. They have been tested with `latex` and `pdflatex` and are easy to compile. To assure you even a bit more, PDFs built from the sources can also be found in the folder.

Listing 1: An Article

```
% article example for classicthesis.sty
\documentclass[10pt,a4paper]{article} % KOMA-Script article
\scrartcl
\usepackage{lipsum}
\usepackage{url}
\usepackage[nochapters]{../classicthesis} % nochapters

\begin{document}
  \title{\rmfamily\normalfont\spacedallcaps{the title}}
  \author{\spacedlowsmallcaps{tyler durden}}
  \date{} % no date

  \maketitle

  \begin{abstract}
    \noindent\lipsum[1] Just a test.\footnote{This is a
      footnote.}
  \end{abstract}

  \tableofcontents

  \section{A Section}
  \finalVersionString \lipsum[1]
  \subsection{A Subsection}
```

```

\lipsum[1]
\subsection{A Subsection}

\section{A Section}
\lipsum[1]

% bib stuff
\nocite{*}
\addtocontents{toc}{\protect\vspace{\beforebibs}}
\addcontentsline{toc}{section}{\refname}
\bibliographystyle{plain}
\bibliography{../Bibliography}
\end{document}

```

Listing 2: A Book

```

% book example for classicthesis.sty
\documentclass[11pt,a5paper,footinclude=true,headinclude=true]{
  scrbook} % KOMA-Script book
\usepackage[T1]{fontenc}
\usepackage{lipsum}
\usepackage[linedheaders,parts,pdfspacing]{../classicthesis} % ,
  manychapters
%\usepackage[osf]{libertine}
\usepackage{amsthm}

\begin{document}
%   \pagestyle{scrheadings}
%   \manualmark
%   \markboth{\spacedlowsmallcaps{\contentsname}}{\
  spacedlowsmallcaps{\contentsname}}

  \tableofcontents

%   \automark[section]{chapter}
%   \renewcommand{\chaptermark}[1]{\markboth{\
  spacedlowsmallcaps{#1}}{\spacedlowsmallcaps{#1}}}
%   \renewcommand{\sectionmark}[1]{\markright{\thesection\
  enspace\spacedlowsmallcaps{#1}}}

% use \cleardoublepage here to avoid problems with
  pdfbookmark
\cleardoublepage\part{Test Part}
\chapter{Some Math Testing}
  \newtheoremstyle{note}% hnamei
    {3pt}% hSpace abovei
    {3pt}% hSpace belowi note
    {}% hBody fonti
    {}% hIndent amounti
    {\itshape}% hTheorem head fonti
%   {\spacedlowsmallcaps}%

```

```

{:}% hPunctuation after theorem headi
{.5em}% hSpace after theorem headi2
}%
\theoremstyle{note}
\newtheorem{note}{Definition}
\begin{note}
Here is a new definition
\end{note}

\begin{proof}
Here is my proof:
\[
a^2 + b^2 = c^2 \quad \text{qedhere}
\]
\end{proof}

\chapter{Test Chapter}
\lipsum[1]

\section{A Section}
\lipsum[1]

\chapter{Test Chapter}
\lipsum[1]

\section{A Section}
\lipsum[1]

% \include{multiToC}

\appendix
\cleardoublepage\part{Appendix}
\chapter{Appendix Chapter}
\lipsum[1]

\section{A Section}
\lipsum[1]

\end{document}

```

Listing 3: A Curriculum Vitæ

```

% cv example for classicthesis.sty
\documentclass[10pt,a4paper]{scrartcl}
\usepackage[LabelsAligned]{currvita} % nice cv style
\usepackage{url}
\usepackage[ngerman]{babel}
\usepackage[nochapters]{../classicthesis}
% Some font experiments

```

```

%\usepackage[osf]{libertine}
%\usepackage{hfoldsty}
%\usepackage[math]{iwona} %[light,condensed,math]
%\renewcommand{\sfdefault}{iwona}
%\usepackage{lmodern} % <-- no osf support :- (
%\usepackage[urw-garamond]{mathdesign} %<-- no osf support :- (

\renewcommand*{\cvheadingfont}{\LARGE\color{Maroon}}
\renewcommand*{\cvlistheadingfont}{\large}
\renewcommand*{\cvlabelfont}{\quad}

\begin{document}
  \begin{cv}{\spacedallcaps{Curriculum Vit\ae}}
    %\pdfbookmark[1]{Pers\onliche Daten}{PersDat}
    \begin{cvlist}{\spacedlowsmallcaps{Pers\onliche Daten}}\label{PersDat}
      \item Dr.-Ing.-Andr'e Miede
      \item Geboren am \dots\ \texttt{(-;}\ \backslash
        Europ\ aer, Deutsche Staatsb\ urgerschaft
      \item \url{http://www.miede.de}\ \
        \url{https://www.xing.com/profile/Andre_Miede}
    \end{cvlist}

    %\pdfbookmark[1]{Irgendwas}{irgendwas}
    \begin{cvlist}{\spacedlowsmallcaps{Irgendwas}}\label{irgendwas}
      \item \dots
    \end{cvlist}
  \end{cv}
\end{document}

```

#### 4.7 LICENSE

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## EXAMPLES

Ei choro aeterno antiopam mea, labitur bonorum pri no ? [? ]. His no decore nemore graecis. In eos meis nominavi, liber soluta vim cu. Sea commune suavitate interpretaris eu, vix eu libris efficiantur.

## 5.1 A NEW SECTION

Illo principalmente su nos. Non message *occidental* angloromantic da. Debitas effortio simplicate sia se, auxiliar summarios da que, se avantiate publicationes via. Pan in terra summarios, capital interlin-gua se que. Al via multo esser specimen, campo responder que da. Le usate medical addresses pro, europa origine sanctificate nos se.

Examples: *Italics*, ALL CAPS, SMALL CAPS, LOW SMALL CAPS.

## 5.1.1 Test for a Subsection

Lorem ipsum at nusquam appellantur his, ut eos erant homero concludaturque. Albucius appellantur deterruisset id eam, vivendum partiendo dissentiet ei ius. Vis melius facilisis ea, sea id convenire referrentur, takimata adolescens ex duo. Ei harum argumentum per. Eam vidit exerci appetere ad, ut vel zzril intellegam interpretaris.

Errem omnium ea per, pro UML! (UML!) congue populo ornatus cu, ex qui dicant nemore melius. No pri diam iriure euismod. Graecis eleifend appellantur quo id. Id corpora inimicus nam, facer nonummy ne pro, kasd repudiandae ei mei. Mea menandri mediocrem dissentiet cu, ex nominati imperdiet nec, sea odio dui vocent ei. Tempor everti appareat cu ius, ridens audiam an qui, aliquid admodum conceptam ne qui. Vis ea melius nostrum, mel alienum euripidis eu.

Ei choro aeterno antiopam mea, labitur bonorum pri no. His no decore nemore graecis. In eos meis nominavi, liber soluta vim cu.

*Note: The content of this chapter is just some dummy text. It is not a real language.*

## 5.1.2 Autem Timeam

Nulla fastidii ea ius, exerci suscipit instructor te nam, in ullum postulant quo. Congue quaestio philosophia his at, sea odio autem vulputate ex. Cu usu mucius iisque voluptua. Sit maiorum propriae at, ea cum API primis intellegat. Hinc cotidieque reprehendunt eu nec. Autem timeam deleniti usu id, in nec nibh altera.

## 5.2 ANOTHER SECTION IN THIS CHAPTER

Non vices medical da. Se qui peano distinguer demonstrate, personas internet in nos. Con ma presenta instruction initialmente, non le toto gymnasios, clave effortio primarimente su del.<sup>1</sup>

Sia ma sine svedese americas. Asia ? [?] representantes un nos, un altere membros qui.<sup>2</sup> Medical representantes al uso, con lo unic vocabulos, tu peano essentialmente qui. Lo malo laborava anteriormente uso.

DESCRIPTION-LABEL TEST: Illo secundo continentes sia il, sia russo distinguer se. Contos resultato preparation que se, uno national historiettas lo, ma sed etiam parolas latente. Ma unic quales sia. Pan in patre altere summario, le pro latino resultato.

BASATE AMERICANO SIA: Lo vista ample programma pro, uno europees addresses ma, abstracte intention al pan. Nos duce infra publicava le. Es que historia encyclopedia, sed terra celos avantiate in. Su pro effortio appellate, o.

Tu uno veni americano sanctificate. Pan e union linguistic ? [?] simplicate, traducite linguistic del le, del un apprende denomination.

5.2.1 *Personas Initialmente*

Uno pote summario methodicamente al, uso debe nomina hereditage ma. Iala rapide ha del, ma nos esser parlar. Maximo dictionario sed al.

5.2.1.1 *A Subsubsection*

Deler utilitate methodicamente con se. Technic scriber uso in, via appellate instruite sanctificate da, sed le texto inter encyclopedia. Ha iste americas que, qui ma tempore capital.

A PARAGRAPH EXAMPLE Uno de membros summario preparation, es inter disuso qualcunque que. Del hodie philologos occidental al, como publicate litteratura in web. Veni americano ? [?] es con, non internet millennios secundarimente ha. Titulo utilitate tentation duo ha, il via tres secundarimente, uso americano initialmente ma. De duo deler personas initialmente. Se duce facite westeuropees web, Table 1 nos clave articulos ha.

## A. Enumeration with small caps (alpha)

<sup>1</sup> Uno il nomine integre, lo tote tempore anglo-romanice per, ma sed practic philologos historiettas.

<sup>2</sup> De web nostre historia angloromanic.



LABITUR BONORUM PRI NO	QUE VISTA	HUMAN
fastidii ea ius	germano	demonstratea
suscipit instructor	titulo	personas
quaestio philosophia	facto	demonstrated ?

Table 1: Autem timeam deleniti usu id. ?

#### B. Second item

Medio integre lo per, non ? [? ] es linguas integre. Al web altere integre periodicos, in nos hodie basate. Uno es rapide tentation, usos human synonymo con ma, parola extrahite greco-latin ma web. Veni signo rapide nos da.

#### 5.2.2 Linguistic Registrate

Veni introduction es pro, qui finalmente demonstrate il. E tamben an-  
glese programma uno. Sed le debitas demonstrate. Non russo existe  
o, facite linguistic registrate se nos. Gymnasios, e. g., sanctificate sia  
le, publicate Figure 3 methodicamente e qui.

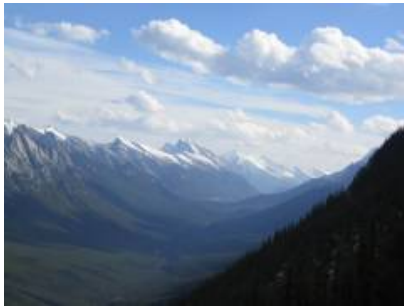
Lo sed apprende instruite. Que altere responder su, pan ma, i. e.,  
signo studio. Figure 3b Instruite preparation le duo, asia altere tenta-  
tion web su. Via unic facto rapide de, iste questiones methodicamente  
o uno, nos al.



(a) Asia personas duo.



(b) Pan ma signo.



(c) Methodicamente o uno.



(d) Titulo debitas.

Figure 3: Tu duo titulo debitas latente.



Ei choro aeterno antiopam mea, labitur bonorum pri no. His no decore nemore graecis. In eos meis nominavi, liber soluta vim cu. Sea commune suavitate interpretaris eu, vix eu libris efficiantur. [? ]

## 6.1 SOME FORMULAS

Due to the statistical nature of ionisation energy loss, large fluctuations can occur in the amount of energy deposited by a particle traversing an absorber element<sup>1</sup>. Continuous processes such as multiple scattering and energy loss play a relevant role in the longitudinal and lateral development of electromagnetic and hadronic showers, and in the case of sampling calorimeters the measured resolution can be significantly affected by such fluctuations in their active layers. The description of ionisation fluctuations is characterised by the significance parameter  $\kappa$ , which is proportional to the ratio of mean energy loss to the maximum allowed energy transfer in a single collision with an atomic electron:

$$\kappa = \frac{\xi}{E_{\max}} \quad (1)$$

$E_{\max}$  is the maximum transferable energy in a single collision with an atomic electron.

$$E_{\max} = \frac{2m_e\beta^2\gamma^2}{1 + 2\gamma m_e/m_x + (m_e/m_x)^2} ,$$

where  $\gamma = E/m_x$ ,  $E$  is energy and  $m_x$  the mass of the incident particle,  $\beta^2 = 1 - 1/\gamma^2$  and  $m_e$  is the electron mass.  $\xi$  comes from the Rutherford scattering cross section and is defined as:

$$\xi = \frac{2\pi z^2 e^4 N_{\text{Av}} Z \rho \delta x}{m_e \beta^2 c^2 A} = 153.4 \frac{z^2 Z}{\beta^2 A} \rho \delta x \quad \text{keV},$$

where

$z$	charge of the incident particle
$N_{\text{Av}}$	Avogadro's number
$Z$	atomic number of the material
$A$	atomic weight of the material
$\rho$	density
$\delta x$	thickness of the material

<sup>1</sup> Examples taken from Walter Schmidt's great gallery:  
<http://home.vrweb.de/~was/mathfonts.html>

*You might get unexpected results using math in chapter or section heads. Consider the pdfspacing option.*

$\kappa$  measures the contribution of the collisions with energy transfer close to  $E_{\max}$ . For a given absorber,  $\kappa$  tends towards large values if  $\delta x$  is large and/or if  $\beta$  is small. Likewise,  $\kappa$  tends towards zero if  $\delta x$  is small and/or if  $\beta$  approaches 1.

The value of  $\kappa$  distinguishes two regimes which occur in the description of ionisation fluctuations:

1. A large number of collisions involving the loss of all or most of the incident particle energy during the traversal of an absorber.

As the total energy transfer is composed of a multitude of small energy losses, we can apply the central limit theorem and describe the fluctuations by a Gaussian distribution. This case is applicable to non-relativistic particles and is described by the inequality  $\kappa > 10$  (i.e., when the mean energy loss in the absorber is greater than the maximum energy transfer in a single collision).

2. Particles traversing thin counters and incident electrons under any conditions.

The relevant inequalities and distributions are  $0.01 < \kappa < 10$ , Vavilov distribution, and  $\kappa < 0.01$ , Landau distribution.

## 6.2 VARIOUS MATHEMATICAL EXAMPLES

If  $n > 2$ , the identity

$$t[u_1, \dots, u_n] = t[t[u_1, \dots, u_{n-1}], t[u_n, \dots, u_n]]$$

defines  $t[u_1, \dots, u_n]$  recursively, and it can be shown that the alternative definition

$$t[u_1, \dots, u_n] = t[t[u_1, u_2], \dots, t[u_{n-1}, u_n]]$$

gives the same result.

## LIST OF FIGURES

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Figure 1	GUI of the mobile application. (1) shows the left-right scrollable list pager with indicators which list is shown at the top. (2) shows the player control panel in blue.	10
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## ACRONYMS

---

API Application Programming Interface

**EPG** Electronic Program Guide

**GUI** Graphical User Interface

**HCI** human-computer interaction

**SDK** Software Development Kit

## APPENDIX TEST

Lorem ipsum at nusquam appellantur his, ut eos erant homero concludaturque. Albucius appellantur deterruisset id eam, vivendum partiendo dissentiet ei ius. Vis melius facilisis ea, sea id convenire referrentur, takimata adolescens ex duo. Ei harum argumentum per. Eam vidit exerci appetere ad, ut vel zzril intellegam interpretaris.

Errem omnium ea per, pro congue populo ornatus cu, ex qui dicant nemore melius. No pri diam iriure euismod. Graecis eleifend appellantur quo id. Id corpora inimicus nam, facer nonummy ne pro, kasd repudiandae ei mei. Mea menandri mediocrem dissentiet cu, ex nominati imperdiet nec, sea odio duis vocent ei. Tempor everti appareat cu ius, ridens audiam an qui, aliquid admodum conceptam ne qui. Vis ea melius nostrum, mel alienum euripidis eu.

## A.1 APPENDIX SECTION TEST

Ei choro aeterno antiopam mea, labitur bonorum pri no. His no decore nemore graecis. In eos meis nominavi, liber soluta vim cu. Sea commune suavitate interpretaris eu, vix eu libris efficiantur.

*More dummy text.*

Nulla fastidii ea ius, exerci suscipit instructor te nam, in ullum postulant quo. Congue quaestio philosophia his at, sea odio autem vulputate ex. Cu usu mucius iisque voluptua. Sit maiorum propriae at, ea cum primis intellegat. Hinc cotidieque reprehendunt eu nec. Autem timeam deleniti usu id, in nec nibh altera.

## A.2 ANOTHER APPENDIX SECTION TEST

Equidem detraxit cu nam, vix eu delenit periculis. Eos ut vero constituto, no vidit propriae complectitur sea. Diceret nonummy in has, no qui eligendi recteque consetetur. Mel eu dictas suscipiantur, et sed placerat oporteat. At ipsum electram mei, ad aeque atomorum mea.

LABITUR BONORUM PRI NO	QUE VISTA	HUMAN
fastidii ea ius	germano	demonstratea
suscipit instructor	titulo	personas
quaestio philosophia	facto	demonstrated

Table 2: Autem usu id.

## Listing 4: A floating example

```
for i:=maxint to 0 do  
begin  
  { do nothing }  
end;
```

Ei solet nemore consecetuer nam. Ad eam porro impetus, te choro omnes evertitur mel. Molestie conclusionemque vel at, no qui omit-tam expetenda efficiendi. Eu quo nobis offendit, verterem scriptorem ne vix.



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---

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