STANFORD
MUSSALLEM CENTER FOR
BIODESIGN

Research Proposal

Proposal Title

Author:
Supervisor: Paul Schmiedmayer, PhD

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Proposal

Create a small abstract that describes your thesis in a few lines. It is a scientific practice that abstracts do not contain citations. It should be a self-contained description of the work you describe in the proposal.
An abstract must contain the following parts:

1. Provide context, e.g., the domain and its importance.
2. Narrow down the problem domain, build up the motivation and identify the problem
3. Define the solution and, e.g., what artifacts you want to build
4. How do you plan to validate/evaluate your results?

Needs Statement

Describe the challenge that you are trying to solve, and describe a promise on how to solve it. Identify a significant, unmet need by observing, collecting, and filtering key information about the involved stakeholders as done in the Biodesign process described by Yock et al. [4]. Refer to *Object-Oriented Software Engineering Using UML, Patterns, and Java* by Bruegge and Dutoit for more information about the similar requirements elicitation and analysis process focused on software systems [1]. You can also use the design science methodology presented by Wieringa to formulate research goals, design problems, and knowledge questions [3].
Your narrative should include the following parts:

1. Provide context, e.g., the domain and its importance.
2. Narrow down to the problem domain and build up the motivation to identify the problem.
3. Establish the research gap: Detail your most important related work and what is missing in the state-of-the-art research. Why is it an important problem to solve? Show clear evidence that it is **not** solved yet.
4. Formulate research goals, design problems, and knowledge questions.

5. Highlight your promise: What you offer to solve the problem, and what are the key properties of your design? Describe the future artifacts that you want to build.

Conclude your problem exploration with a comprehensive summary in the form of a needs statement, following the *"A way to address (problem) in (population) that (outcome)"* [4] format as defined by Yock et al..

Important: Use citations to refer to other scientific work[a]. As shown in the sentence above, you can use footnotes to refer to URLs as a convenience for the reader if you do not cite and refer to non-scientific work.
To keep track of what you are referring to and give yourself the chance to always have this context right in place, you should follow the following guidelines:

```
% [CITE_KEY, SECTION]: "..."
...~\cite{CITE_KEY}
```

Add one or more LaTeX comments above every citation you have that contains the `CITE_KEY`, the `SECTION` you are referring to, as well as the content you are referring to within quotation marks.
If you have a PDF file of the source you are referring to, place it in the sources folder, highlight the cited parts, and name it like the `CITE_KEY`. If you don't have access to a PDF version of the sources, provide a markdown file that contains a link enabling you to access the original (possibly using a Stanford login), as seen with the sources currently used in this proposal.
This proposal provides you with several examples of this guideline. Please cite this proposal template by Schmiedmayer when you use or modify it [2].

[a] You can refer to the Stanford Honor Code for more information about scientific best practices: `https://communitystandards.stanford.edu/policies-guidance/honor-code`

Related Work

Describe related work that has been done in the field and/or is related to your thesis. Collect literature in your `references.bib` file and refer to your collected literature using citations. Compare your proposed research to the current state-of-the-art research. Identify if you provide a completely new approach or if you are improving existing research. Describe how your proposed system differs from existing approaches and the research delta between your work and existing work.
Each related work must be **related to your work**. You should classify and describe it according to two different types of related work:

- Related work can build upon and learn from. You should state what aspects of the related work are important for your research and how you can incorporate them into your design.
- Related work that approached the challenge with a similar approach. State what differentiates your work from the existing work, why it is still relevant, and what additional value it provides.

System Requirements

Describe the requirements that your system should fulfill. Describe the structure and its interaction with other actors. List the functional and non-functional requirements for the system that you will develop as part of your thesis.
Refer to *Object-Oriented Software Engineering Using UML, Patterns, and Java* by Bruegge and Dutoit for more information about functional (4.3.1 Functional Requirements) and nonfunctional requirements (4.3.2 Nonfunctional Requirements) [1].

Functional Requirements

Functional Requirements describe the interactions of the system with its environment without considering implementation details [1].
List and describe all functional requirements of your system. The short title should be in the form "verb objective".

FR1 **Short Title 1**: Description.

FR2 **Short Title 2**: Description.

FR3 **Short Title 3**: Description.

FR4 **Short Title 4**: Description.

Non-Functional Requirements

Non-functional Requirements describe constraints that are not directly linked to the function of the system and describe requirements that apply to many different aspects of the system [1].
List and describe all non-functional requirements of your system. Categorize them using the FURPS+ model described without the category **functionality** that was already covered with the functional requirements [1].

NFR1 **Category 1**: Description.

NFR2 **Category 2**: Description.

NFR3 **Category 3**: Description.

NFR4 **Category 4**: Description.

Expected Outcome

Describe the expected outcome of your thesis:

- Define the key artifacts that you want to produce. This can include source code, documents, articles, scientific publications, and other measurable outcomes that you want to focus on.
- Explain the key design challenges you can face and how you solved them.
- Tell about your key validation or evaluation aspects: benchmarks, case studies, and important takeaways that you plan to validate or evaluate. Connect the evaluation or validation with the research goals defined by the problem statement.

Time Schedule

Provide multiple milestones that you can use to check your progress while working on the thesis. Don't be too detailed to keep room for an agile process but identify the significant milestones you want to meet based on the previous sections.

Milestone 1 - Date 1: Description.

Milestone 2 - Date 2: Description.

Milestone 3 - Date 3: Description.

Milestone 4 - Date 4: Description.

Bibliography

[1] Bernd Bruegge and Allen H. Dutoit. *Object-Oriented Software Engineering Using UML, Patterns, and Java*. Pearson Education Limited, 3rd edition, 2013. ISBN 978-1-292-02401-1.

[2] Paul Schmiedmayer. Proposal Template. URL `https://github.com/StanfordBDHG/ProposalTemplate`.

[3] Roel J. Wieringa. *Design Science Methodology for Information Systems and Software Engineering*. Springer, 2014.

[4] Paul .G. Yock, Stefanos Zenios, Josh Makower, Todd J. Brinton, Uday N. Kumar, F. T. Jay Watkins, Lyn Denend, Thomas M. Krummel, and Christine Q. Kurihara. *Biodesign: The Process of Innovating Medical Technologies*. Cambridge University Press, 2015. ISBN 9781316195581.