Master Thesis Topic Description

1. Resolving Conflicts in Emotional Requirements by Stakeholders for Sociotechnical System


This master's thesis topic will be a continuation of the work in Gulten (2021), with a focus on harmonizing emotional requirements in goal-oriented requirements engineering (GORE) for socio-technical systems (STS). In the thesis, we want to look at the socio-technical nature of problem domains, consisting of social and human actors, processes, and the technology they use. Within the premise of these combinations, requirements elicitation and analysis can be very complex since humans are involved.

The main research question the thesis seeks to answer is: How can conflicts in emotional requirements that are expressed as emotional goals for different stakeholders be identified and resolved? The overarching goal will be to try out further the methods used in Gulten (2021) in other domains to further prove the approach's validity. The reason for that is to identify gaps of employed methods and, thus, work on their improvement. Alternatively, it is also possible to develop a new method to identify and resolve conflicts in stakeholders' emotional goals. The focus will be on exploring human psychology to understand every stakeholder's motivations, intentions, and emotions amidst conflicting situations during software development projects and harmonizing their concern. Since emotions are a complex system in themselves, studying them also requires hard and long work.

Interestingly, as it is in any system development situation, a number of techniques including, but not limited to (i) Goal modeling (it has ways to annotate inconsistent/conflicting goals), (ii) formal specification (followed by formal methods aimed at discovering logical inconsistencies), (iii) hazard analysis, (iv) domain modeling, (v) use case modeling, help identify and resolve inconsistencies/conflicts in requirements. We think it is possible to leverage these techniques and apply any of them in the master's thesis. Modeling in general, with each model, where it does not come together exposes an inconsistency or conflicts. Noticeably, none of these work without people thinking carefully because they involve understanding the world and real-life cases.

On the other hand, techniques such as Win-Win (Ross and Boehm) start from identified inconsistencies in requirements to find a way to resolve them without making any losers. It is possible to consider this by treating emotional requirements as any other requirement and then doing RE tasks with them. For example, with the goal modeling approach, the emotional requirements can be added to the goal model, and then carry out the conflict analysis with them.

Other techniques are Analytic Hierarchy Process (AHP), Argumentation Technique (AT), Delphi Techniques (DT), Machine Learning Technique (MLT), and using mathematical modeling/approach to describe human emotions and resolve conflicts. Therefore, if you are comfortable and interested in using any of the techniques mentioned above, you are the right candidate for the topic.

Additional Reading: for this topic:


2. **Systematic Literature Review on the Extent of Conflict Resolution Research and Practice in Requirements Engineering of Socio-technical Systems: How far did we come?**


Identifying and resolving conflicts are genuine requirements engineering (RE) problems that can positively impact many application domains (Gambo and Taveter, 2021). This alone has made requirements conflicts an essential focus for research in the RE community (Yu and Mylopoulos, 1998).

This topic is concerned with providing an overview of the efforts researchers have made to address conflicts in the requirements engineering (RE) process, especially conflicts in stakeholders' requirements, goals, and concerns. Also, the thesis topic seeks to abridge and explicate the existing evidence concerning (i) the inevitability of conflicting situations during RE mentioned in the literature (ii) the number of existing techniques in the literature that have been used to handle conflicts during the RE process and the most reported methods for identifying, capturing, analyzing, representing and resolving these conflicts, (iii) the gaps or drawbacks of existing techniques (iv) the classification of these techniques if any (v) the associated software engineering (SE) processes; and (vi) the collective and increasing interest of researchers and practitioners in addressing conflicts in the RE process. Interestingly, no existing SLR focuses on conflict management in RE concerning the development of STSs from both researchers' and practitioners' views.
More specifically, the thesis topic aims to provide several but hopefully a comprehensive review of the significant efforts undertaken along this line of research by investigating and summarizing findings. This is with the view of having a clearer and broader perspective on how conflicts in the RE process are handled in practice to improve the quality of STSs and achieve stakeholders' satisfaction. The thesis will further seek to uncover and identify potential areas for research maximizing conflict resolution as an integral part of the decision-making process in achieving mutual consensus by stakeholders in a development project.

Possible research questions (RQs) to achieve the aim of this study could be:

- **RQ1**: How much of the existing literature specified the need for conflict resolution in RE? With **RQ1**, we seek to know the number and types of publication, source of the publication, authors, and their affiliations. With this in mind, researchers and practitioners will have a broader view of the research attention to dealing with conflicts or inconsistencies in RE.

- **RQ2**: What are the current practices in the industry for identifying and resolving conflicts in a development project?

- **RQ3**: How do the current practices support stakeholders' decision-making process and mutual satisfaction in a development project?

- **RQ4**: How many of the conflict resolution techniques exist in the literature? We are interested in identifying the number of existing techniques addressing conflict resolution in the literature during RE. Secondly, we are interested in knowing the method(s) most reported in the literature to identify, capture, categorize and resolve conflicts.

- **RQ5**: What taxonomy or classification of these techniques exist in the literature and their areas of application? We want to streamline these techniques into groups base on the application domain or problem domain.

- **RQ6**: What are the SE processes existing solutions are associated with, and the supporting theories in the literature in handling conflicts during RE?

- **RQ7**: What are the gaps or setbacks in the literature on the reported techniques/methods for conflict resolution?

For this thesis, the student will be required to read the existing literature and later conduct empirical research.


### 3. Conflicts Management in GORE: Socio-Technical Systems Perspective


Conflict management is a genuine problem in many design systems [1]. So further development in this area could be highly beneficial and has scope to impact across many domains. The problem of conflict management in requirements is further aggravated by the iterative nature of agile software engineering (SE) methodologies [2], where requirements should be changed and elaborated repeatedly along with the iterations of an agile SE process [3].
In goal-oriented requirements engineering (GORE), requirements are treated as goals [4]. Handling conflicts in goals is one of the active research areas in GORE [5 - 7]. GORE expresses the statements by the stakeholders concerning the desired system as goals to be achieved by the system. In socio-technical systems (STS), the goals are achieved through the cooperation of man-made agents within the software-to-be and human agents. As stakeholders frequently pursue mismatching goals, identification and resolution of conflicts in requirements is an inevitable part of GORE. For this master's thesis, we want to investigate the identification and resolution of conflicts in the requirements within the agile agent-oriented modeling (AAOM) method [8] methodology for engineering STS. The main objective is to develop a strategy and its supporting tool for conflicts identification and resolution in GORE for STS in the context of AAOM. AAOM is derived from agent-oriented modeling (AOM) [9].

The thesis proposes using the notions of STS and "agent" to understand and represent conflicts in requirements to be more easily identified and resolved. STS in this context consists of diverse, active components - both human and man-made - that collaborate in designing and sustaining the STS. Remarkably, STSs are designed to meet business goals [10]. Agents pursue two kinds of goals: functional and non-functional goals. In [9], a functional goal is defined as a particular state of affairs intended by one or more active entities - agents - in the STS and a non-functional or quality goal as a quality requirement for achieving the functional goal.

This master's thesis topic is expected to (i) advanced conflict identification and resolution strategy for GORE for STS within the AAOM Methodology, (ii) propose a conflict identification and resolution strategy that works with hierarchical goal models. The proposed strategy should take advantage of (a) attachment of the corresponding roles to goals of the hierarchical goal model, which naturally brings out needs and intentions by the corresponding stakeholders, and (b) relating the goal models to the most famous artifacts of agile SE - user stories - which will naturally enable conflict management in the context of agile SE.

References


4. Engineering Learning Techniques for Predictive Privacy Modelling and Analysis of Socio-Technical Systems


The Master thesis topic addresses and satisfies privacy requirements during the requirements engineering (RE) process. The overarching goal is to exploit, support, or mitigate the interplay between privacy concerns and human behavior. The focus will be on assets and threats that happen before a system is built. In this regard, understanding the group dynamics of people, especially in a given problem domain (for example, the healthcare system), will be investigated.

In context, ascertaining privacy solutions for socio-technical systems (STS) is a difficult and error-prone task because their heterogeneity and complexity have limited the traditional RE methodologies in terms of eliciting or capturing the privacy expectations of stakeholders. This Master thesis will develop an appropriate learning technique require to balance the various privacy needs from both technical and human perspectives by understanding the group dynamics of people. The data set will comprise features on how people react and behave under different situations. The goal is to understand privacy concerns and analyze group dynamics using group theory, social norms, and social identity theory. The thesis will further explore the satisfaction level of building systems that cater to privacy problems. There is the possibility of using a supervised learning technique with associated learning algorithms to analyze data used for classification and provide the correct mapping from input to output. Additionally, suitable techniques, especially argumentation techniques (the reason for the different alternatives and behaviors), can prove that these systems are correct. It is possible to use the healthcare system or any suitable problem domain as a case study.

In summary, the master thesis will focus on engineering a technique that learns new privacy policies for dynamic adaptive systems, thereby providing continuous satisfaction of privacy requirements for STS.

**Recommended References**


5. Investigating the Extent of Architecture-based Testing: industrial practices and needs


Software architecture and software testing have already been considered together. However, there is much to be gained from the cooperation between them. The architecture of a system can have a straightforward impact on its testability. The testing can provide valuable feedback to the architectural design process and significantly impact the quality of the delivered system.

In an attempt to progress the cooperation between these fields, workshops, conferences, and meetings have been organized over the years. For example, the WICSA workshop on "Architecture-Based Testing and System Validation", the charrette session at AST, the IEEE/ACM ICSE international workshop on Automation of Software Test, the ROSATEA workshops on "The Role of Software Architecture for Testing and Analysis". Still, a systematic study linking those two domains is missing.

This master's thesis topic wants to investigate the current role of software architecture in the testing of complex software systems and the role of software testing in the architecting process. The main research question is: what are the industrial practices and needs related to architecture-based testing? Further questions from the main research question include: (i) do software testers use the system software architecture to plan the testing campaign? (ii) do software testers provide feedback to architects on how to improve the system architecture? (iii) do software architects design the architecture to make it more testable?

The goal for the Master thesis is to understand (i) how industries practice software architectures (do they have a software architecture team, how do they define software architecture, how they specify it, …), (ii) how industries practice software testing (do they have a software testing team, how do they define a software testing plan, automation and tools, …), (iii) if there is any link between those two roles, (iv) what industry thinks their needs are, and so on. I have outlined the guidelines on how to conduct the study for anyone interested in this topic.

6. Scenarios and semantic support/description (ontologies) in requirements engineering


Using ontologies in requirements engineering activities (RE) activities is beneficial to the industry and academia. Some of these benefits include addressing and overcoming ambiguities, inconsistencies, and incompleteness of requirements. The interest in this master thesis topic is on scenarios with semantic description (ontologies). The idea is to describe the text of the scenarios in a not ambiguous way, that is, with some ontology, that will provide a precise definition of the terms and the relationship between the terms. Of particular interest, the master thesis will develop a strategy for writing scenarios describing a given problem domain. The goal is to develop a technique to facilitate RE activities, such as elicitation, analysis, specification, validation, and management in a large collaborative design. The focus will be on a given problem domain and case study.
Scenarios in this context are descriptions similar to use cases. However, there are differences, but they can be thought of as similar tools. Both of them can be used as techniques in analyzing and documenting functional requirements. With the use cases, one can think of how a user interacts with the system, think through where variations, exceptions can occur and determine what is true before starting the requirements in the path. This gives a better view of scenarios!

7. A Model for Detecting and Resolving Conflicts in Features Extracted from App User Reviews


Recently, many approaches have been proposed to analyze user reviews of mobile Apps [1 – 5], identify key features from App User Reviews [6], detect human values-violation in App Reviews [7], and extract software features from mobile App user reviews [8], among several others. To the best of our knowledge, there is no existing research that focuses on detecting and resolving conflicts from the App User Reviews at the same time. Additionally, the existing approaches do not allow software engineers to find conflicting requirements on specific functionality and features extracted. Worthy of mention is that these recent works have used natural language processing (NLP) and deep machine learning (ML) techniques as the primary approaches for achieving the intended goal of the research.

We acknowledge that both NLP and ML approaches generally contribute to the success stories behind recent development and accomplishment in applied computing, especially in the software engineering domain. These success stories are visible even in requirements engineering for ML-based systems, especially with the emergence of new quality requirements such as explainability [9].

Therefore, for this thesis, first, we want to establish that conflicts exist in the reviews given by users on mobile apps. Because of that, we want to detect these conflicts using suitable techniques to be worked out. After that, we want to resolve these conflicts to have more precise and consistent requirements/features extracted from the reviews to improve the requirements elicitation and analysis process. The method we intend to work out will be based on the automatic detection of conflicts in the extracted App reviews made by users. The overarching goal will be to develop an automated model for extracting features from apps reviews, detecting conceptual overlap to find potential candidates of conflicts, and resolving them accordingly. We foresee integrating domain knowledge to engender significant improvement in conflict detection and resolution accuracy. The evaluation of the strategy/approach can be based on industrial practices.

Reference


8. Developing a Web Augmentation Tool for Supporting End-User Ancillary Searches

MSc./BSc.


Searching is a major task in web applications that necessitate developing new tools to support the user and provide a better experience. Notably, End-User Development (EUD) provides promising techniques and strategies to build such supporting tools, especially in a context where manipulating textual information is still dominant and visual metaphors and new interaction paradigms could improve the whole search experience. Usually, in EUD research, the problem comes from end-users; thus, it would be interesting to know the users' opinions about the tool's usefulness and customize the visualization of results in the tool description. Remarkably, the users are meant to perform an extra task about the creation of a search service. Therefore, this master's thesis will focus on developing a tool to help users conduct web search tasks to support their primary task.

Additionally, this topic aims at describing a web browser add-on as a tool to support end-users in creating personalized ancillary searches. Ancillary search, in this context, is the search that allows a user to look for complementary information in a web browser to achieve another main task. Also, the topic will involve performing further experiments to evaluate the usability of the tool for creating search services. For example, the System Usability Scale (SUS) questionnaire might be used, and qualitative data collected in evaluating the proposed tool. Also, testing with other web applications could further expand the research and demonstrate the tool's usability. Thus, it will be interesting to find a better site with multi-language support to run the experiments in groups or individually. For example, a site in Estonian, Russian and English languages can be a good idea.

In the end, the student is expected to execute both formative and summative evaluation with many participants (i.e., real users) to compare users’ performance when using traditional search and search services created with the tool. Moreover, statistical analysis will be required in the comparative experiment about the significance of the emerging differences between execution times. A t-test could be adopted in this case or any suitable test. It is expected that a training session is performed with these real users before asking them to use the tool for evaluation purposes.

Additional Reading: for this topic:


