

A Tool for Participatory Negotiation: LINKing-UP Participatory Design and Design Knowledge Reuse

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ABSTRACT

We describe a web-based prototype that enhances participatory design by providing participatory negotiation mechanisms between designers and potential end-users of a proposed system. As a module of LINK-UP, a repository for reusable design knowledge, our tool complements scenario-based design processes, helping designers and potential end-users improve consensus. Negotiation spans a whole design cycle, but our initial focus is on requirements analysis. We report promising results from a pilot evaluation and suggest directions that will further improve the synthesis of participatory design, reuse of design knowledge, and development of design-support tools.

Keywords

Notification systems, scenarios, claims, critical parameters

INTRODUCTION

Motivated by the growing influence of participatory design in HCI [1, 3, 9], we explore how potential end-users and system designers can derive consensus about design goals and outcomes throughout the design life cycle of a proposed system through participatory negotiation. Although many design methodologies (e.g. scenario-based design [8]) provide mechanisms for problem analysis using various participatory design techniques, they do not always afford explicit means for end-users to derive consensus amongst themselves or even with system designers.

We focus our interface design research on a particular class of systems, a metaphor for interface design at-large. *Notification systems* are computer interfaces normally used in divided-attention situations to access information from alternate sources [6]. Examples of notification systems include news tickers, automobile displays and system or network monitors. *LINK-UP*, or (Leveraging Integrated

Notification Knowledge with Usability Parameters), is an integrated design environment for notification systems that allows designers to go through the whole design cycle while accessing and creating reusable design knowledge. It provides modular interactive tools that support various design activities right from requirements analysis through to the evaluation of design prototypes [2]. Using a scenario-based design approach [8], LINK-UP enables designers create better systems by helping them to focus on the *critical parameters* for notification system design—essential psychological usage goals relating to interruption, reaction, and comprehension, or *IRC parameters* [5]. LINK-UP provides support tools that enable designers to better understand the functioning of proposed notification systems and to assess the impacts of various propositions.

Participatory Negotiation with LINK-UP

While Rosson and Carroll [8] argue that scenario-based design can help facilitate participatory design by providing a universally accessible language to all stakeholders in design, there are no formal methods, processes or tools that support negotiation between potential system end-users and system designers at various stages of the design process. Just like participatory design, negotiation can be used in all stages of a design process to generate consensus on goals and outcomes. For this prototype, we focus mainly at the requirements analysis phase. This is mainly motivated by that the fact that requirements definition is one of the most crucial steps in the design of any successful system.

We prototyped a participatory negotiation module that allows comparisons between the *design model* (expressing the designer's interpretation of user requirements) with the *user's model* (characterizing the actual user's experience)—concepts originally introduced by Norman (1986), by relying mainly on the underlying critical parameters of the envisaged notification system.

COMPONENT DESIGN AND IMPLEMENTATION

Given our motivation to enhance participatory design by providing negotiating mechanisms that enable system designers to reach consensus with potential end users early in the design stages of notification systems, we started off

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by reviewing literature on various participatory practices [4, 7]. Taking into account the nature of activities that both designers and users would engage in, and the fact that our module would function within the larger framework of the

LINK-UP system, we brainstormed multiple ideas while talking to potential designers and users. We began our development with low-fidelity prototype storyboards that

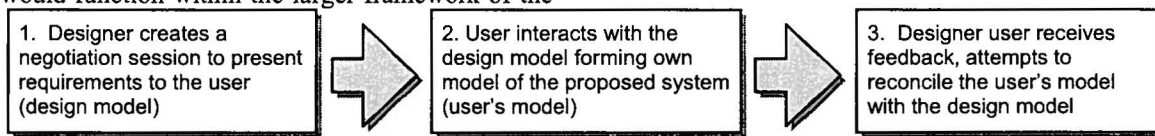


Figure 1. Three components of the Participatory Negotiation module in LINK-UP.

allowed potential users to walk-through the tasks that they would need to do to achieve our goals, allowing us to quickly collect feedback and design tools that would support participatory negotiation of user requirements.

Two types of users are supported by the module, designers and potential end-users. To support the task flow and the high-level steps required to establish a negotiation environment between a designer and a user, we divided the participatory negotiation module into three components (see Figure 1). The whole module is implemented in JavaServer Pages (JSP) and Java Servlet technology to create a dynamic web based environment that interacts with the LINK-UP database via SQL.

Using the *Create Negotiation Component (1)*, the designer creates a negotiation session. This entails assembling the requirements that consist of: the *root concept*—outlining the proposed system’s high level goals and rationale, identification of stakeholders, and explicit statement of constraining starting assumptions; *problem scenarios*—stories of current practice that reveal aspects of the intended users or “actors” and their activities with implications for design; and *problem claims*—identifying features that are interesting or have important effects on the actors, to create a design model of the proposed notification system. The designer also highlights the *situation features*—anything with notable effect on the experience of actors in the problem scenario and matches them up with the relevant problem claims. Any artifacts collected during the requirements gathering process are included as part of the requirements [8]. In addition, the component guides the designer to create a series of questions that probe the adequacy of different parts of the requirements, a user background survey as well as instructions that help guide the users through the participatory negotiation session.

The *User Negotiation Component (2)* presents the design model created by the designer in the first stage to the users. Each user gets an opportunity to review the root concept, problem scenarios and claims related to the proposed design. They review the designer selected situation features and have an opportunity to add more from each problem scenario, before matching them to the relevant problem claims where applicable. Through the process each user responds to questions ranked on a 5-point Likert scale to

signify their level of agreement with the suitability of the various parts of the requirements. They complete the session with a post questionnaire about the participatory negotiation process and a user background survey.

The *Resolution Component (3)* collects all the feedback from the users, aggregates it, and provides the resulting feedback to the designer with recommendations on how to proceed. Recommendations are given for each part of requirements based on the mean and standard deviation of the aggregated responses (from all the users participating in the session) to questions relating to that part of the requirements (see Figure 2). The resulting parameter values for the problem claims from the participatory negotiation session are presented alongside those selected by the designer in earlier phases, indicating a match, minimal mismatch or mismatch between the two. Where users provide comments, a link appears next to the relevant section, allowing the designer to easily access them for elaboration. All this provides the designer with a sense of how well they established the requirements for their proposed system from the point of view of potential end-users, as well as several areas they might improve the requirements specification.

PILOT EVALUATION

We conducted a four stage pilot evaluation of the participatory negotiation module. The first step involved using notification system designers to actually create a negotiation session, the second step involved ordinary users of proposed systems participating in a negotiation session, the third stage involved using an expert in notification systems to participate in a similar negotiation session on their own, while the fourth and final stage involved presenting all the resulting feedback from the negotiation sessions back to the system designers. The use of an expert was meant as a control, to validate that what we expected of the ordinary users was indeed possible to do. We wanted to answer two main questions in the evaluation:

- Would users be able to match problem claims to a particular situation features inherent in a problem scenario?
- Do designers find the feedback that we collect from the users relevant in determining how to proceed with their design?

The first question was motivated by assertions made by proponents of the scenario-based design that it can facilitate participatory design by providing a universally accessible language to all stakeholders in design [8]. The second

question relates to the utility of this module as a part of LINK-UP—we wanted to create a tool that would be useful to designers and enhance LINK-UP as a design tool for notification systems.

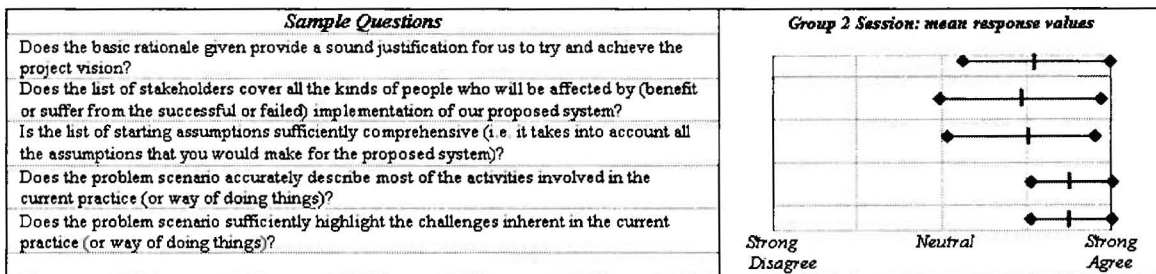


Figure 2. Sample negotiation session questions and participant response values (shown with standard deviation) from pilot testing.

We had a total of 16 participants in our evaluation. Two participated as designers; they were computer science undergraduates, attending a seminar on the design and evaluation of notification systems. They each helped create a negotiation session from their seminar design project and reviewed feedback about their design project from the users. Twelve participated as users; they were undergraduate sophomores from the business school. We were interested in ordinary, representative users who were non computer science undergraduates as participants for the participatory negotiation session. The last two participated as experts; they are graduate students in computer science with extensive knowledge in notification systems design.

Creating a negotiation session

In the first stage of the evaluation, designers used the Create Negotiation Component to assemble the requirements for the proposed system and put together a survey for the users' participatory negotiation session. The requirements include the root concept, the problem scenarios and their situation features, as well as claims for their proposed system. In addition, they included a series of questions meant to elicit user feedback on various parts of the requirements. While these questions were selected from a default set created to probe specific aspects, the designers could also create their own questions to help probe other issues of interest.

The first designer used an earlier paper prototype based on our storyboards to create our first negotiation session. During this portion of the evaluation, we were interested in uncovering obstacles that would hinder a designer from successfully creating a negotiation session. Some of the issues that emerged from this session included the need to incorporate an example that would run through the length of the component to help augment the instructions that we provide to the designers at various stages. We also moved the section where the designer creates instructions for the negotiation session from the beginning to the end, the rationale being that having assembled all the requirements

in the order that they would want to present them, the designer was in a better position to create better instructions. This session lasted for about an hour and half.

The second designer used the finished prototype, where we had rectified the problems we noted and ideas that emerged from the first session. He did not ask for many clarifications and completed the session in under an hour.

Participating in a negotiation session

In the second stage of the evaluation, a group of participants were given a brief introduction to notification systems in general and to scenario-based design. They were then presented with the requirements put together by the designer and led through a discussion by a facilitator that lasted about 20 minutes. The discussion was meant to help build common ground. After the discussion, each participant would then use the Negotiation Component to provide individual feedback. The feedback included answering questions (rated on a five-point Likert scale) on the appropriateness of the root concept, the problem scenarios and the parameter suitability for the problem claims. Participants were asked to match the situation features from each scenario with the relevant problem claim as a way to gauge their appreciation of the problem domain. They also completed two post questionnaires; the first, to assess their opinion on the utility of the method as a mechanism for providing input to the design process and the second, to provide information about their background. We had two groups of six participants; each group using a session created by one of the designers in the first stage. Group sessions lasted for about an hour on the average. In the third stage, we had an expert user go through the same session (with no discussion at the beginning) to provide a benchmark and to validate that what we expected of the users was reasonable.

Reviewing results from a negotiation session

In the fourth stage of the evaluation, we presented the results from the negotiation session to the designers. Using the Resolution Component, we aggregate the group results

and made recommendations to the designer on how to proceed. After reviewing the results, the designer answered a questionnaire that determined how useful they had found the user input from the negotiation session and whether they would incorporate it in subsequent design activity. This was followed by an in-depth interview where we helped the designer delve deeper into the data by employing various filtering techniques on the user group.

RESULTS AND DISCUSSION

Based on results from Group 1 of the negotiation session (see Figure 2), half of the participants correctly matched five out of the seven situation features to the right problem claims. Two matched four, while one matched two of the seven, a success rate of only 59.5%. In terms of designer and user parameter matching for the problem claims, there were five matches, five minimal matches and five mismatches. In Group 2, one user correctly matched five of six situation features to the right problem claims, while the rest of the group correctly matched four of six (66.67%). For this group, designer and user parameter matching for the problem claims resulted in three matches, four minimal matches and five mismatches. Based on this, we can say:

- Participants understood the notion of matching situation features to the claims, although they often disagreed with problems designers felt were important.

The results were presented to the designers along with recommendations. After reviewing them, both designers found them to be very useful (3 on 3-point Likert scale). They rated the feedback on the problem claims as the most useful, while feedback on the problem scenarios was the least useful. Both designers felt that they would be able to:

- Incorporate feedback into their general design ideas,
- Use the feedback to modify the design requirements.

Perhaps the most interesting aspects emerged from the questionnaire, when designers were asked to make suggestions on how the user feedback could be improved to make it more useful to them. Both designers wanted to:

- Understand the user demographics behind the feedback, helping them gauge how seriously to treat it.

In the subsequent interview that followed, they got an opportunity to look at the actual data. One of them suggested filtering out users who had successfully matched more situation features to problem claims, since they would trust their feedback more. From the interviews, it became apparent that we need to provide designers with tools to help them better manipulate the participant population and review the resulting feedback. They also highlighted the need for more guidance to help them create better questions for the participant background survey that could provide more insight about the participants.

CONCLUSION AND FUTURE WORK

We have designed and validated a web-based tool that helps designers build and execute a participatory negotiation session. Although we have found features within this module that can be improved upon, we are pleased with the general results and the potential for scenario-based design rationale components (i.e., claims and scenarios) as a central and reusable basis for participatory negotiation. Since LINK-UP includes a store of reusable design rationale [2], incorporating the participatory negotiation module with this system provides a mechanism for harvesting user opinions about notification design artifacts. The module helps keep group discussion sessions focused on critical questions about the design requirements, strengthening our understanding about using critical parameters to guide design decision-making.

We have noted several avenues for future work. First, we have observed the importance of devising mechanisms to capture aspects of group discussion with negotiation session results, using this data to improve user filtering for the designer. Along this line, we will also include better tools that allow the designer to view feedback by applying different filters to the user population—a full information visualization solution. Having validated the module as being useful within a requirements analysis process, a next step will be to emulate the model to support other critical points in the design stages that follow. With these broader features in place, in the long-term, we will be able to investigate the influence of earlier feedback by looking at decisions made in the subsequent design stages. We are excited about the current and future possibilities for general participatory design research enabled by our module.

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