

Strategies in the Collaborative Use of Design Patterns

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Abstract. Originally proposed as a tool for knowledge representation and sharing addressing architects, the concept of design pattern has been adopted by other domains as well. This led to new and innovative ways of using it and its usefulness is largely recognized in the literature. However, little work has been done in investigating and measuring the impact a collection of patterns has on collaborative design processes involving designers. The paper describes the results of a case study involving 18 teams of undergraduate students in Computer Science. Making use of a collection of design patterns for the design of synchronous applications and being observed by a facilitator, they were asked to design applications which support synchronous collaboration. Abstracting from a) the sequences of actions the teams performed on the collection of patterns in isolated contexts of their design processes, b) the ratio of each category of actions the teams performed, and c) the facilitator's notes on the participants' interactions, a set of strategies the participants developed while using the patterns were identified and are presented in the paper.

Introduction

Originally proposed as a tool for knowledge representation and sharing addressing architects (Alexander, 1977), the concept of design pattern – defined as “a proven solution to a recurring design problem” (Borchers, 2001) – has been adopted by other domains as well. This led to new and innovative ways of using it and its usefulness is largely recognized in the literature. On the one hand, software engineering applies design patterns for expressing Object-Oriented software

design experience (Gamma, 1995). On the other hand, HCI designers adopted the design pattern approach to document and describe “the reasons for design decisions and the experience from past projects, to create a corporate memory of design knowledge” (Borchers, 2001; Schummer, 2007). In addition to that, patterns have been extensively used in teaching (Kolfschoten, 2010), bridging communication gaps between users and designers (Dearden, 2002), and abstracting results of ethnographic studies of cooperative work (Martin, 2002).

However, little work has been done in investigating and measuring the impact a collection of patterns has on collaborative design processes involving designers. This paper aims at providing some insight into the matter by describing a case study designed to answer the following question: “*What strategies do novice designers develop in working with a collection of design patterns?*” 18 design workshops were conducted with 18 teams of undergraduate students in Computer Science. They were provided with a collection of design patterns addressing the design of synchronous collaborative applications and were asked to use it in designing such an application. The patterns were identified through a 2-phase process fully described in (Iacob, 2011), comprising: 1) the analysis of the results of the design processes followed by 13 teams of designers, and 2) the analysis of 20 existing applications which support synchronous collaboration in activities such as drawing, text editing, searching, and games. The patterns included in the collection are briefly described below:

- **Who is the coordinator?** addresses the problem of providing a coordination mechanism which: a). allows all collaborators to take part in the collaboration and b). maintains the resource in a consistent state at all times.
- **Integrated chat** addresses the problem of supporting the communication among collaborators.
- **Eyes wide open** addresses the problem of allowing each collaborator to be notified about what the others are contributing to the process at any time.
- **Choose your collaborators** suggests allowing each user to be able to choose the people s/he wants to work with during the collaboration.
- **Collaboration, always social** suggests integrating social features in order to support the collaborators in forming a community.
- **With or without collaboration** addresses the issue of providing users with an additional private area, not available to the other collaborators.
- **My contribution** addresses the problem of supporting the identification of each individual’s contribution to the collaborative process.
- **Track history of collaboration** suggests saving the history of the collaborative process and making it available through repositories, or log files.
- **Adapt application to device** suggests supporting the materialization of the application on various devices.
- **Annotate** suggests allowing users to enhance the shared resource with textual, audio, or video notes on the misunderstandings they might have.

- **Support versioning** indicates enhancing the application with a versioning mechanism able to support the collaborators in viewing and editing older versions of the document they are working on.
- **Collaborative undo** suggests supporting the users in undoing changes performed on the shared document, maintaining the resource consistent.
- **Customize collaboration** points to providing the collaborators with the possibility of customizing the parameters of their collaborative process.
- **Shared summary** suggests providing the collaborators with an automatic way to create summaries of their collaborative processes.
- **Resume collaboration** suggests allowing the collaborators to pause their collaborative process, and restore it later.

Case Study

This section presents a case study conducted for identifying the impact a collection of design patterns addressing the design of synchronous applications has on the collaborative design of such applications by novice software designers. 18 design workshops were conducted with 18 teams of undergraduate students in Computer Science. Making use of the patterns described above, they were asked to design the GUI and the interaction process of an application to support synchronous collaboration in activities such as drawing, text editing, game solving, and searching. Each pattern was represented on a paper card, being described by its *name*, its unique *ID*, the set of *keywords* associated to it, a representative *illustration*, the *problem* addressed by the pattern, and the *solution* proposed to tackle the problem.

The participants' design processes were audio recorded, a facilitator observed their interactions, and each participant provided his/her feedback on the workshop through a questionnaire. The recorded conversations of all the teams were transcribed. Their dialogues were divided into sentences (i.e. small fragments of dialogues – usually lines of the dialogues – related to a particular concept or action), all those sentences containing references to the patterns provided being filtered and considered for further analysis. The coding scheme used for coding the sentences referencing patterns classified these sentences as indicating: a) *browsing* the collection, b) *reading* a pattern, c) *using* a solution, d) *adapting* a pattern, e) *modifying* a pattern, f) *searching* for a pattern, g) *explaining* a pattern to another member of the team, h) *re-referencing* a pattern, and h) *generating* a design idea pointing to a pattern.

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Abstracting from a) the sequences of actions the teams performed on the collection of patterns in isolated contexts of their design processes (as defined through the coding scheme), b) the ratio of each category of actions the teams performed, and c) the facilitator's notes on the participants' interactions, a set of

strategies the participants developed while using the design patterns were identified.

Customize Pattern Identification

In going through the patterns and trying to get familiar with the problems addressed by them, the teams often tried to associate each pattern with a characteristic word. Having done that, their dialogs would contain references to the patterns through the words associated to them (e.g. *“We can decide on a fixed time for all the game and during the game one can take maximum 2 breaks, and then we look into the solution for the pause one [the pattern Resume collaboration]”*). Interesting enough, these words were not consciously chosen from the list of keywords provided in the description of the patterns. However, with the exception of one case, all the words the teams associated with the patterns already belonged to the list of keywords provided by the cards.

Two of the teams filtered the collection of patterns after going through it and discussing it once and chose a subset of these patterns they considered fundamental for their design process. Throughout their work, they referred mostly to these patterns.

Signal Patterns

Often times, while some of the members of a team were focusing on the design task, the other(s) browsed the collection of patterns and tried to relate the team's design decisions to the solutions proposed by the patterns. When the team member(s) browsing the patterns identified a useful pattern at a specific moment, s/he signaled this pattern to the team. Some examples of such references are: *“Ok, there is a thing I read here [My contribution]: for understanding who has placed a certain piece”*, or *“Look at this, this is interesting [points to pattern With or without collaboration] When you solve a puzzle you should have a private area where you try out the pieces and when a piece works well where it is placed, you just add it to the whole puzzle”*.

Search – Analyze - Apply

The most common strategy the teams were expected to choose consisted in: a) initiate by writing down possible problems they would face, b) browse the collection of patterns searching for those patterns documenting the problems they considered, c) point to a pattern once found and read it, d) analyze the solutions proposed by the pattern and assess which solution to apply. Contrary to the expectations, less than half of the teams adopted this precise path of actions. However, all of the teams performed at least two of these actions during their design processes.

Patterns as Checklists

Eight out of the 18 teams used the collection of patterns also as a checklist. They initiated their work after going through the patterns, but initially ignored them. After reaching an idea for the application they were designing and sketching a draft of it, they went through all the patterns, one by one, in order to make sure that they covered all the issues addressed by the collection. For each of the patterns, they analyzed whether they considered the issue addressed by the pattern. In the affirmative case, they identified the solution they adopted. In the negative

case, they explained the reasons for which the pattern did not apply to their design context.

Patterns as Startup Tools

Four of the teams initiated their design processes by going through the patterns, one by one, and identifying how could the pattern be applied in the context of their application's design. Then, when faced with a problem during their design process, the teams tried to remember which of the patterns addressed that problem. Examples of such references are: *"Yes, there was a pattern on that"*, or *"There was one [pattern] that was mentioning the saving... because if we are 5 and we decide to save, we should be able to do that"*. Moreover, specific situations faced during the design process reminded the teams of the patterns they browsed at the beginning of the process. As example of such a reference, consider *"Exactly, this was one of the issues in the patterns. If one clicks on the piece and drags it, in that moment that piece is locked"*.

Patterns as Source of Inspiration

A common behavior of all the teams was to consult the patterns ever so often during their design processes. This helped them explore their design options and take informed decisions on the solutions to consider applying. Moreover, once going through the patterns, the teams would consider problems and design ideas they wouldn't have considered otherwise. Patterns inspired the teams in adding elements to their designs, and some example of references to such situations are: *"Let's add something about notifications [after reading Eyes wide open]"*, or *"How do they choose the collaborators? [pointing to the pattern Choose your collaborators]"*.

Mark the Use

The final result provided by each team was a sketch or a mockup of their overall design. No strategy was suggested to the participants for marking the patterns used. However, there were three ways they decided to address this. The majority of the teams grouped together all the patterns they used, putting them aside. Others have decided to arrange the patterns in the order they used them throughout the process. A more systematic approach was adopted by two of the teams which annotated their sketched with the IDs of the patterns they used, marking the use of each pattern in a specific context of the application's design.

What do you mean?

Patterns were often used as means of making oneself understood. The teams used the patterns in order to explain each other concepts or to discuss open issues or misunderstandings. For example, one of the most challenging concepts to grasp was reverting changes, the teams making use of the Collaborative undo pattern to explain each other the concept and the way it can be addressed in the context of the applications they were designing. Similar results have been identified in [3].

Beyond Patterns

During their work with the patterns, some of the teams went beyond the definition provided by the cards and pointed out examples of applications of the patterns in software systems commonly used. Moreover, one of the teams identified possible relationships existing between patterns. For example, they considered the patterns Track history of collaboration, Collaborative undo, and Support versioning related

to each other, even if they did not specify exactly in which way these patterns are related. A similar association was identified among the patterns Collaboration, always social, Annotate, and Customize collaboration.

Discussion and Conclusions

The strategies described above trigger a set of implications to the use of design patterns in collaborative design processes: a) Initiating by going through a problem-solution knowledge repository related to the design domain allows the designers to frame their ideas, and better understand the further implications of their early design decisions, b) As searching in such a repository is the most common action designers are expected to perform, the representation of such a knowledge base should consider including a straightforward way of querying it, c) Using patterns collaboratively, designers should be able to signal patterns to one another, supporting them in sharing knowledge, d) Marking the use of the patterns directly on the design result (mockups, models) allows documenting design processes, supporting their review and understandability, e) A design pattern collection may be used as a checklist to support validating design results, models and decisions. As future work, professional software designers will be involved in such collaborative processes and their strategies and their feedback will be comparatively analyzed with those obtained from the current study.

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