

Brownies as Assistants

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Abstract

This contribution discusses the use of assisting agents in interactive configuration systems. With so-called brownies a new metaphor for assisting agents is explored which guides the functional design but avoids the presentation problem.

The metaphor can be stretched to include socially interacting agents which can support large-scale configurations.

Interactive configuration

Configuration problems have a long history in AI going back to the pioneering R1/XCON expert system for configuring computer systems [McDermott 82]. Industrial systems have demonstrated the usefulness and applicability of the methods developed. However, the division of labour between system and user has been rather simple: The user specifies the problem and the system solves it. Correspondingly simple is the interaction between system and user. Also, this kind of interaction restricts configuration problem solving to areas where the problems can completely be specified a-priori. Only recently this restriction has been addressed. In the KIKon project [Emde et. al. 96] an alternative approach is taken: While the user is configuring manually, the system permanently checks the growing configuration. This results in an inverse division of work, but the interaction between system and user is still rather simple.

Interaction in KIKon falls into the category of *direct manipulation* which, according to [Shneiderman 83], requires the user to initiate all tasks explicitly. Assisting agents suggest another interaction style which has been referred to as *indirect management* in [Kay 90]. Here, the interaction between user and computer is a cooperative process where all participants may initiate communication and perform tasks, instead of unidirectional interaction via commands and/or direct manipulation. The agent becomes an assistant which shares the user's workspace [Maes 94]. It operates in parallel to the user. The agent can observe the user, it can make intelligent recommendations, and it can perform explicitly delegated tasks.

Using assisting agents in an interactive configuration system is highly desirable. The user can focus on the more difficult parts of the configuration because routine

tasks and repetitive tasks are carried out by the agents. While the user determines the principal design his assistants may explore alternatives and suggest improvements. Unlike direct manipulation systems, a truly interactive configuration system can profit from agents with very different competences [Voß et al. 92].

The agent presentation problem

Agents with different capabilities must exhibit some degree of personality or character so that the user can recognize individual agents, the agents can acquire credibility, and the user can suitably appreciate their contributions.

But how should an agent, as a third party beside the user and the application system, present itself at the user interface level? Its appearance will raise certain expectations and reactions of the user and they should conform to the agent's competence [Erickson 97]. For instance an agent producing its output in natural language might be expected to accept its input in natural language as well.

So how to stage agents on the screen? Should they appear with a human visage, as an animated character, as a special symbol, or just in a special dialog box? Regarding the variety of agent services in commercial and industrial systems, an absolute answer to this question cannot be expected.¹

Besides such portraying issues there are functional considerations such as how to give the right information at the right time. In the following we present brownies as a metaphor which transports the functional role of agents but avoids the portraying problem. Furthermore this metaphor allows to extend a direct manipulation interface of an interactive configurator to an indirect management style.

¹ For example, the Microsoft Office Package offers eight different assistants, each with a completely different visualization ranging from an animated logo to a cartoon professor.

Brownies: a metaphor for agent functionality

The term *brownie* has several meanings. We do not mean a small cake, but a little object which invisibly supports a human being. Brownies have several desirable properties. At first, they are invisible. So there is no need to portray them to the human user. Secondly, they typically come in bunches. Often, brownies have individual skills that enable them to perform special tasks.

In the tales brownies do not interact directly with humans. It is only through their modifications of the environment that humans become aware of them.

To understand what this could mean for interactive configuration let us draw an analogy. In some respects, interactive configuration is like editing. Instead of a text a configuration is edited, and instead of a spelling corrector a consistency checker is invoked. In a simple text editor, the user would have to activate the spelling corrector explicitly, a better text editor might run the spelling corrector concurrently. An advanced editor might even recognize that the user has started writing a business letter and would provide text fragments to fill in. While even automatic spelling correction may become a nuisance, one definitely would not like the editor to add sentences directly into the letter one is writing. Analogously, brownies should not directly modify the configuration which the user is editing.

A brownie should observe the user's work and generate a contribution which the user is free to integrate into his version. These contributions should be collected in a folder, which can be sorted according to different criteria. At any time the user can search his folder for interesting contributions, display contributions or select one for further usage. The selected contribution can simply be pasted into the user's work or the user's configuration can be adapted to the contribution using different adaptation strategies. So a brownie and a user

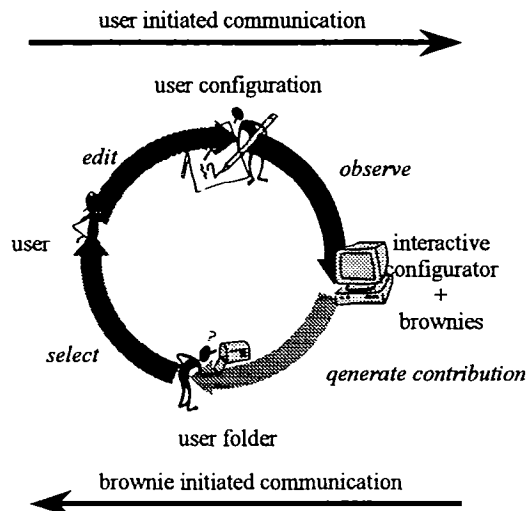


Figure 1: Interaction between user and brownies

interact indirectly by moving pieces of configurations between the folder and the user's configuration.

By introducing brownies, the interaction style of a direct manipulation configurator can be extended to indirect management. A brownie can select and perform tasks on its own. By sending a contribution to the user's folder, the brownie initiates a simple communication with the user (see figure 1).

Agents with different capabilities can be realized by different problem solvers. To let the user adapt his expectations to the different kinds of agents, it is sufficient to mark each contribution in the folder with its source. This can be type of the agent. Similarly, in human collaboration, it is sufficient to know the names of the persons who contributed a suggestion.

Helping each other

According to [Takeuchi & Naito 95] social interaction requires first that a computer can identify multiple participants of an interaction, second that its behavior is not only determined by internal logic but also affected by the perceived external situation, and finally that it actively joins the interaction. This notion of social interaction is especially useful in domains where a computer must be able to perform autonomous actions in order to assist or to improve a problematic situation. Additionally, in these domains the roles of the participants must be clearly distinguished. Brownies, by their definitional characteristics, satisfy some requirements for social interaction: Brownies observe their environment and take each chance to join the interaction between the user and the configurator.

On the other hand brownies, as we have sketched them above, are surprisingly selfish. Each brownie is only concerned with its own goal and ignores the goals of the other brownies. Correspondingly there is no interaction between them. But this is too restrictive for large-scale configurations problems. They are too complex to be solved in a single attempt. Subproblems must be identified and solved, alternatives should be produced, the best contributions must be selected and integrated into a coherent solution. This must be done concurrently and coordinatedly by several agents. Some of these agents should be mere assistants, others have to assume manager functions, develop configurations and integrate contributions from their assistants. Assistants observe a manager's evolving configuration, identify subproblems in their area of competence, and return the results of their efforts. It is transparent to the managers whether their assistants are themselves managers.

Brownies as introduced above can serve as assistants. Technically, they can be formalized by rules like *when <trigger> if <context> then <action>*. The trigger mechanism determines if a brownie is eligible to become active, and the context operator checks for the preconditions which allow the action to be carried out. Managers are like users. They must be able to collect the suggestions generated by their assistants, to select the best among them and to integrate it into the current configuration. Therefore the folder and the integration mechanisms developed for a human user can be reused to

turn brownies into manager agents: A manager brownie must be given a folder and it must be able to inspect other brownies' configurations (see figure 2).

By observing other brownies and helping them a brownie achieves a social behavior. In contrast to its priorly selfish behavior it is now concerned with others. This new aspect nicely fits to the idea of computer-based assistance: The user is assisted by a society of brownies.

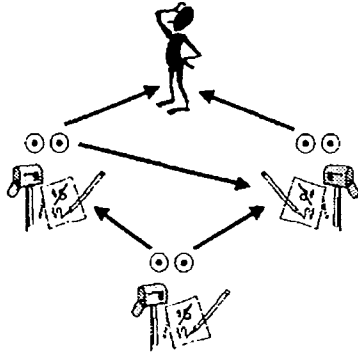


Figure 2: Brownies as managers and assistants

Conclusions

In this paper we presented the brownie metaphor for computer assistance. The metaphor consists of invisible competence specialists which support the user of an interactive configurator by generating contributions. Each specialist is an autonomous, reactive, and goal-oriented process.

For large-scale configurations the autonomy of a brownie is essential, but its selfishness is harmful. The specialists need to assume social behaviors to assist each other in tackling a complex task.

So far we have used component-based and case-based configurators to provide brownies with different competences. The system is being applied to the configuration of telecooperation systems. A major effort was put in integrating contributions into a configuration. Therefore several replay and reconfiguration strategies have been developed. Given this framework, we are now able to shift our research to the social interaction of brownies.

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