Changing the Role of the User: First Results of a New Approach to Scenario Based Product Design

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Introduction

Traditionally, the product design process is referred to as a problem solving activity in which the result is determined by a series of technical decisions (Pahl and Beitz, 1984; Suh, 1990). Recently, the product design process is more and more considered to be a group activity in which communication and collaboration between human actors plays a central role (Sohlenius, 1992; Lu, 2003). In addition to designers, these human actors may include people such as production engineers, maintenance engineers, marketers, representatives from legal institutions and – last but not least – potential users of the proposed product.
This recent paradigm shift with regard to design activity marks the beginning of a new era: an era in which the user's role in design processes will change from being 'problem-provider' and 'solution-evaluator' to being 'proactive participant' and maybe even 'autonomous decision maker'. At the same time, designers will become 'moderators' whose main task it is to define constraints to the design process and to facilitate the communication and negotiation processes between users.
This paper presents a new product design method that conforms to the changing roles of users and designers. The method is based on a unique combination of the use of scenarios (Carroll, 2000), virtual reality simulation (Van Houten, 2001; Tideman et al., 2004) and gaming principles (Ehn and Sjoegren, 1991). This paper also describes an experiment in which the existence of one of the mechanisms essential to successful application of the new product design method is verified.

A new method for scenario based product design

Basic principles

By combining the use of scenarios with VR simulation and gaming principles, the new design method allows intended users of the proposed product to reveal and verify their needs, desires and requirements in an early stage of the design process.
The backbone of this new method for scenario based product design is the simulation model. This simulation model consists of two main elements - a situation database and a

solution database. The situation database contains the set of elements that represent the design problem, whereas the solution database contains the set of technology that might be of use in solving the design problem. Both databases are created and maintained by the designer. Therefore, the designer can also be called the ‘moderator of the simulation’ or, in a broader sense, the ‘moderator of the design process’. By means of a VR simulation system, a user can have lifelike interaction with the contents of both databases.
A scenario is formed by a combination of elements from the situation database together with a task description. A user experiences a scenario by trying to perform the task in the simulated environment. From these experiences, the user may identify problems, needs, desires and requirements. By combining elements from the solution database, the user can configure a solution (product design) with which he or she expects to solve the identified problems, satisfy the identified needs, fulfil the identified desires and meet the identified requirements.
By applying this self-configured solution to the scenario, the user can assess whether his or her expectations about the behaviour, performance and functionality of the design were correct. By applying the design to a different scenario (i.e. a different combination of elements from the situation database), the user can test whether it also functions satisfactorily under different circumstances or whether maybe new problems, needs, desires and requirements emerge. At any point during the simulation, the user is allowed to alter the configuration of the design or even to start all over again with a completely different design.

Two phases

When using this method for scenario based product design, the design process is split into two separate phases. In both phases, the user’s and designer’s activities are quite similar. However, the aims of both phases differ from each other. The first phase is aimed at developing the design environment to be a valid representation of the part of the real world that is relevant to the design case. The ‘problem space’ and the ‘solution space’ are established within the situation database and the solution database, respectively, whereas the possibility to realistically interact with the ‘problem-solution space’ is attained by creating the VR simulation system. During the second phase of the design process, the design environment - as it was created during the first phase - is used to define candidate designs that have a good chance to function satisfactorily in the real world.

Evaluation of the new product design method

Introduction

There are three mechanisms that are essential for successful application of the proposed method for scenario based product design:

- During the first phase of the design process, users should be able to provide feedback on the quality of the design environment (i.e. the degree to which the design environment provides a complete and correct description of the world

relevant to the design case). Moreover, the designer should be able to combine all gathered feedback into an unambiguous list of required adaptations to the design environment;
- During the first phase of the design process, the designer should be able to implement the required adaptations into the simulation model. Moreover, when confronted with the implemented adaptations, users should agree to them and confirm that they have been implemented correctly;
- During the second phase of the design process, users should be able to define a design that they personally find to be attractive.

The experiment described in this paper is aimed at verifying the existence of the first mechanism. Future research will address the other two mechanisms.

Specification of the experiment

The experiment is performed against the background of a design case – the design of a lane change support system. Such a system supports the driver of a vehicle while executing a lane change manoeuvre. A lane change manoeuvre is defined as a manoeuvre in which the vehicle moves to an adjacent lane, either purposely or accidentally.

First, an initial design environment is created. Next, users are invited to participate in design sessions. Finally, users are asked opinions about the quality of the design environment. After all design sessions are finished, the designer attempts to combine all captured information into an unambiguous list of required adaptations to the design environment.

For this experiment, twelve people were invited. All participants have at least five years of driving experience and drive at least 10.000 km per year. Within the group of participants, variations exist in gender, age and education level. Additionally, variations exist in ‘perspective on driver support systems’ (consumer perspective versus professional perspective) and in ‘difficulty in getting familiar with new computer interfaces’ (much difficulty versus little difficulty).

The initial design environment

Based on results from observing the world, reading literature and talking to stakeholders, an initial design environment was created. This design environment provides a user with means for configuring a lane change support system design (see figure 1), and with means for assessing this design within traffic scenarios (see figure 2). Thus, the created design environment consists of three main elements:

- A traffic scenario configurator;
- A lane change support system configurator;
- A driving simulator.

The traffic scenario configurator is operated by the designer, whereas the lane change support system configurator is operated by the user. The user interface of the support system configurator is formed by a touch screen. By completing an electronic questionnaire on this touch screen, a user can configure a lane change support system design.

Figure 1. Configuring a design

Figure 2. Assessing a design

The driving simulator enables the user to realistically experience the behaviour, performance and functionality of the design in traffic scenarios. It consists of a mock-up of a vehicle, a large curved screen that displays the traffic environment, and a sound-system that displays sounds from the traffic environment. The mock-up itself consists of a force feedback steering wheel and a pedal set, a driver's seat equipped with vibrating elements, four flat screens that together form a dashboard, three flat screens that offer rear view mirror functionality, and an in-car sound system. With these interfaces, not only can the vehicle be controlled, but also all possible kinds of lane change support can be offered to and experienced by the driver.

Results of the design sessions

The aim of the experiment was to test whether participants were able to provide feedback on the quality of the design environment (i.e. the degree to which the design environment provides a complete and correct description of the world relevant to the design case). The experiment revealed that all participants were able to successfully participate in the design sessions. Every participant understood his or her role, was able to act according to this role, and provided information about the quality of the design environment. These abilities did not appear to depend on gender, age, education level, 'perspective on driver support systems' and 'difficulty in getting familiar with new computer interfaces'. Both adaptations to the situation database (the set of traffic scenarios) and adaptations to the solution database (the possibilities offered by the lane change support system configurator) were proposed. The proposals were clearly aimed at improving the quality of the design environment, which was in line with the expectations prior to the experiment. Every participant gave similar information about the quality of the design environment. However, while providing information, it appeared that 'driver support system consumers' tend to exclusively reason from their own perspective, whereas 'driver support system professionals' often also take other perspectives into account.

The secondary aim of the experiment was to test whether the designer was able to combine all gathered feedback into an unambiguous list of required adaptations to the design environment. Because none of the proposed adaptations were contradictory, the designer was able to successfully do so. Accordingly, it is concluded that the first

mechanism essential to successful application of the proposed method for scenario based product design exists. This conclusion forms a solid basis for future experiments in which the existence of the other two essential mechanisms is tested:

- Whether the adaptations can be implemented and whether users' opinions about the implemented adaptations are such that the design environment can be said to have become a better representation of the world relevant to the design case;
- Whether users are able to define a design that they personally find to be attractive.

Conclusion

We are on the verge of an era in which the user's role in design processes is likely to radically change. Users are likely to become 'designers' who define their own products, whereas designers become 'moderators' who define constraints and facilitate the communication and negotiation processes between users and other stakeholders. The goal of these developments is to design better products: products that not only comply with the preferences of all intended users, but also function satisfactorily under all imaginable circumstances. To successfully attain this goal, there is a need for a new design approach as well as for new design tools that adequately support this approach. The new method for scenario based product design - as proposed and evaluated in this paper – has the potential to fulfil both needs.

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