

## Participatory techniques for the design of a new input device

### PAPER SUMMARY

Topic Category:	Usability method implementation or adaptation
Presentation Type	Description of a participatory design method
Intended Audience:	Topics for People Who Are Experienced in Usability but New to the Topic Topics for People Who Are Experienced in Usability and the Topic Friends and Allies
Keywords:	Participatory <i>design</i> , <i>Prototyping</i> , <i>Interaction design</i>

### YOUR BACKGROUND IN THIS MATERIAL

This project was for us a first attempt of relying on participatory techniques to bring people from different backgrounds, including users, work together on a product design. However design techniques involving user participation have been used in previous projects.

### ABSTRACT

We present a participatory design method that we have experimented in the design process of a new input device based on handwriting. We will explain how bringing all stakeholders of the product design work together with users through working sessions helped defining the device interaction.

### INTRODUCTION

Everyday day, research on new technologies brings out a range of new devices and new interaction capabilities. However, technology creators are often unsure whether or not their inventions answer a real user need and how users will turn out to use it, if at all.

Usability specialists need methods for understanding how people will turn out to interact with devices relying on new technologies, when these devices do not exist already. They also need methods to efficiently communicate this knowledge to the engineers working on new technologies and to integrate user input into the design process of such products. We believe that addressing these questions should help in designing more useful and usable products.

We set out to address these questions in a project aiming to explore the feasibility of a new handwriting device meant to enable people to communicate with computers, PDAs or mobile phones. This “communicating pen” relies on micro-sensor technology for capturing hand movements [1], and on wireless technology (Bluetooth) for transmitting the resulting data (immediately or later) to the target device. Our more specific goal in the project was to help sharpen the concept, to learn about how exactly the device will turn out to be used, in order to better pin down the functionality and orient its design.

Partners involved in the project came from different backgrounds: accelerometers and magnetometers industry, microelectronics, telecommunication, and software engineering. They all had their own goals and interests, as well as a particular point of view toward the project. Bridging these different spaces so as to meet the needs of end users and

consumers represented a real challenge. However it was the condition for reaching our goal to help designing a usable product.

Our approach since the early stages of the design process consists in involving the project partners in the process and in adopting a very tight design cycle with frequent feedback between the users and the design team. This is described in [2]. For example, the design team relied on results from user inquiries for defining the pen concept, while the study aiming to identify functional needs and analyze user tasks relied on hypotheses, questions and choices from the design team. The methods involved in this study included a design exercise where users could interact with a 2D mockup in order to “build” their own pens, and the execution of task scenarios with the simulated pens resulting from that design.

### METHODS

This approach adopted in this early stage of the design proved to be productive enough that we decided to maintain a tight collaboration between the users and the design team throughout the remaining stages of the process.

This paper describes the method that we have used in the following stage of the process, which aimed to specify the product functionality and to design the interaction modes. The challenge was to reconcile user requirements with available technical solutions.

We hypothesized that participatory design would facilitate exchanges between all stakeholders involved in the pen design, allowing each one to contribute with its own point of view and expertise. Furthermore, it would help integrating user feedback with technical development throughout the design process.

Participatory design began in the 1980’s in Scandinavia, mainly in the industrial design domain [3]. It is now recognized as a successful approach to the design of interactive technology, and has been carried out under various methods and techniques [4] [5]. Some participatory techniques have recently been experimented in the context of designing information technology artefacts [6].

### DESIGN PROCESS DESCRIPTION

The idea of our approach is to bring all project partners involved in the process to work together with user representatives around a pen prototype design. These partners have different backgrounds and competencies: engineers working on sensor technology, software engineers, telecom engineers, sociologists and usability specialists.

A participatory design process went on for several weeks and comprised six working sessions of 2 to 3 hours, during which the design participants worked together to define each pen function precisely and the overall pen interaction modes. These working sessions involved various exercises and techniques such as brainstorming for idea creation, scenario realization with low-tech material, video recording and comparative analysis of solutions.

#### *Session 1: Participatory design for solution creation*

A first working session took place in our lab. One goal was to allow participants to share a common background about user practices and requirements resulting from the previous user study. During this study, users were asked to execute some task scenarios using the pen to interact with a computer, a PDA and a mobile phone. They could either interact directly on the device or write with the pen on any surface close to the device. Details about this study can be found in [2].

The key results of this study were synthesized to the participants at the beginning of the session. Some examples are:

- the user's interest for the pen varies according to the different contexts of use : the smaller the device screen and the more limited the interaction, the more useful the pen appears to be.
- the way the pen is used varies according to the device: for example, with a personal phone, users tend not to look at the screen while they write an SMS; they also make heavy use of keywords as shortcuts for menu selection. With a PDA, users tend not to switch between the PDA screen and the paper; either they write directly on the screen, or they do everything on paper, including writing navigation symbols.
- Users tended to favor simplicity over the multiplicity of functions; their preference goes to a pen that only retains the most essential functions.
- keeping close to the pen metaphor is important (natural gestures).
- feedback about the pen status is also important.
- users are reluctant to write in isolated letters; they much prefer cursive, connected writing, especially for longer text input.
- handwriting recognition is essential, but it may not be applied automatically in every situation (users may want to keep their handwriting representation).

Based on this common background, the main goal of this working session was to generate as many ideas and solutions as possible. We constituted two different groups, each one including representatives of each expertise domain, so as to potentially explore two parallel design directions. Each group worked to create its own first version of a 2D representation of the pen with a special-purpose interactive design tool (figure 1).

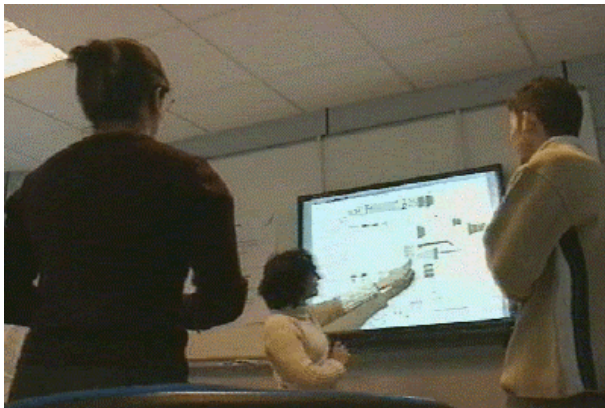


Figure 1. Creation of a 2D pen representation : participants interact with the interactive tool

They also produced a 3D pen mockup, using some low-tech material. During the exercise, the main requirements and design choices coming from the users were posted on the walls so that the team kept them in mind.

One interest of this exercise is that it brings participants exchanging ideas about the basic functions and the pen interaction. Multidisciplinary interaction facilitates the collective understanding of all aspects to be considered in the design and leads to a range of alternatives when there is no consensus.

Then, given some task scenarios, each group had to illustrate solutions through the execution of the scenarios with the 3D

mockup they had built. For example, they were asked to illustrate how they would interact with the pen in order to achieve all the necessary actions for sending an email: open the application, input the recipient address and the subject, write the text of the message and send it. Each participant responsible for a particular idea illustrated it by acting out the corresponding part of the scenario and by explaining the detail of the interaction with the pen. The action was videotaped so that it could be reused in the following steps of the design process (Figure 2).

Acting out their design ideas is for participants a first usability validation of their abstract choices. They may have imagined an interaction solution, for example placing a button in a specific position in order to activate a function, which proves to be difficult to execute in practice, for example because it requires a non natural hand movement.

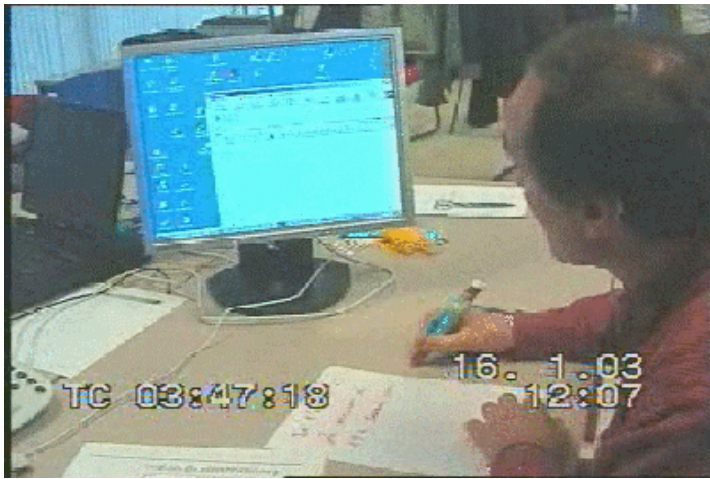


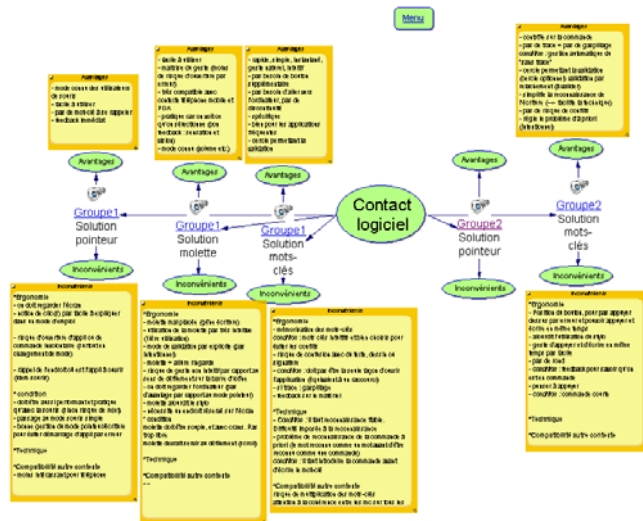
Figure 2. A participant is acting out his solution

The use of videos proved to be a powerful method for observing users realizing some tasks or interacting with a product. Videos have also proved useful in other stages of a design process, for instance in design exploration [7], and even in the entire design activity [8]. In our case, the use of videos serves two main objectives. First, they act as a collective memory. As all the ideas of design solutions proposed by the participants in the first brainstorming session have been recorded, the design process can easily distribute over time without losing any information. Secondly, they help to preserve the intellectual property of each participant regarding their ideas.

A variety of design solutions answering user requirements resulted from this session. Each one covered a subset of the pen functions. All presented some strengths and weaknesses against the technical performance or the interaction usability. The following steps of the design process were oriented toward eliminating the weakest ones and combining the more promising ones until a global pen design appeared reliable enough to be tested with users.

*Sessions 2-4: Participatory design for solution analysis and selection*

The following three working sessions were devoted to analyzing each set of solutions corresponding to a given function or a group of functions, and to select the more promising ones. After the video illustrating each given solution had been played, each participant had to write down the advantages and disadvantages he found to this solution, or the conditions for its acceptance. This could be regarding the technical or ergonomic aspects. Figure 3 illustrates the resulting comments about solutions for connecting the pen with a given application.



When all comments about each solution were compiled, a brainstorming exercise was held in order to select the most promising one. The advantages or disadvantages were classified according to their importance. For example, if one disadvantage was considered fatal from a usability point of view, or totally incompatible with some technical limitations, the solution was eliminated. At the end of the exercise, either one solution emerged as the best one, or a new solution emerged from a combination of the positive aspects of several others. In that case, this new solution was acted and videotaped.

Figure 3. Commenting solutions : advantages are displayed in the yellow boxes at the top while disadvantages are displayed at the bottom.

This solution selection phase resulted in a set of “best choice” design solutions, each one addressing a specific function or group of functions.

*Sessions 5-6: Participatory design for overall interaction design*

Two additional working sessions were held in order to specify a global pen design by putting together in a coherent way all the “function specific” solutions and to validate the resulting overall pen interaction. Again this validation was done by having the participants execute some task scenarios with a 3D pen representation, simulating the interaction as close as possible to the specified one. For example, techniques such as Wizard of Oz were used.

At the end of the selection process, the design specifications were recorded and summarized through a 2D commented representation of the pen (Figure 4).

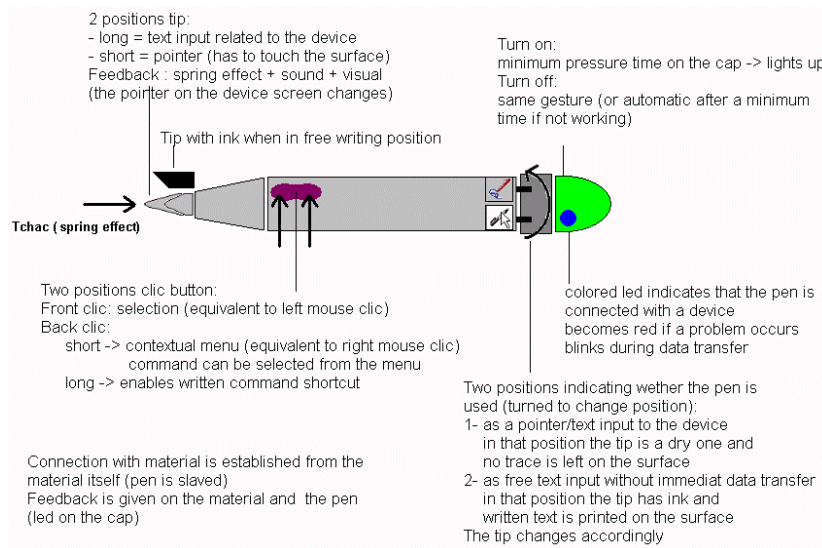


Figure 4. 2D representation of the final pen design

**CONCLUSION**

Overall, we identified several advantages for using a participatory design approach.

The main benefit of bringing stakeholders of the design work together with users is to make the design converge rapidly toward a solution which is compatible with both technical feasibility and product usability. An additional advantage is that each participant gets a better understanding of the others’ preoccupations, which proves useful in the remaining stages of the project.

The use of low-tech material, makes it possible to explore and validate potential solutions without any development effort. However, we found that in this case the material that we used to build the 3D pen mock-up was too limited to allow realistic simulation of some interaction mechanisms. It would appear highly desirable for the UI design community to develop and make available generic 3D prototyping tools.

The next step in the project should consist in prototyping a 3D pen, not necessarily integrating the technology, but implementing the main interaction specifications, in order to validate the design with users through usability testing.

### REFERENCES

1. Joguet, C., Caritu, Y., and David, D. 'Pen-like' natural graphic gesture capture disposal, based on a micro-system. Smart Objects Conference, Grenoble France, May 15-17, 2003.
2. Millien, E. and Roux, C. Users input to the design of a "communicating pen": a participatory approach. Smart Objects Conference, Grenoble France, May 15-17, 2003.
3. Bødker, S., Ehn, P., Kyng, M., Kammersgaard, J., and Sundblad, Y. A UTOPIAN Experience: On design of powerful computer-based tools for skilled graphic workers. In G. Bjerknes, P. Ehn, and M. Kyng (Eds.), *Computers and democracy: A Scandinavian challenge*. Brookfield VT USA: Gower.
4. Muller, M.J. Participatory design: The third space in HCI. In J. Jacko and A. Sears (eds.), in *Handbook of HCI.*, 2002
5. Sanders, E.B.-N. Generative tools for co-designing. *Proc. CoDesigning 2000*. London, Springer, 2000
6. Westerlund, B., Lindqvist, S., Mackay, W., Sundlab, Y. Co-design methods for designing with and for families, *Proc. 5<sup>th</sup> European Academy of Design Conference*, Barcelona, April 2003.
7. Mackay, W.E. and Tatar, D. (1989) Workshop on Video as a Research and Design Tool. Special Issue of the SIGCHI Bulletin. ACM/SIGCHI.
8. Mackay, W., Ratzler, A. & Janecek, P. Video Artifacts for Design: Bridging the Gap between Abstraction and Detail. In *Proc. ACM Conference on Designing Interactive Systems, DIS 2000*, New York, August 2000