

The I-Book: A freely interpretive notebook for biologists

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ABSTRACT

Within the framework of cooperation with biologists, we have realized the I-Book, a tool to collect relevant data for the development of an augmented laboratory notebook. We took as a starting point the technology probes, while insisting on how to support a reflective and creative use of this tool. For that, we introduce the concept of interpretation, a simple method of tailorability which leads the user to reflect on his work and his book, during his work. Our prototype was made by using a new technology, the Anoto pen, which makes it possible to replace a graphic tablet advantageously.

Keywords

Co-Adaptation, Tailorability, Participatory Design, Paper-Based Interface, Anoto Pen.

INTRODUCTION

For a few years, we have been implied in the design of an augmented laboratory notebook for biologists at the Institut Pasteur in Paris. Several prototypes were already made, using Participatory Design techniques [4]. Recently, a new technology enables us to release ourselves from traditional devices of mixed reality such as graphic tablet, or, more cumbersome, projector coupled with cameras. The Anoto Pen allows capturing the strokes made on a book almost like with a tablet, but now, no need to be near a computer, the book can be used anywhere. For the user, is quite like use a normal book and a normal pen, except that he can decide to transfer all that he has wrote to his computer.

The Anoto Pen makes it possible to have a very flexible tool. To explore how biologists would like to use it, we decide to make a probe using this pen. Technology probe [1] is an efficient methodology for designing technology for and with families. It consists in making a simple and flexible artifact which will be employed in its real context with three goals: to test the technology in its real context, to collect data about the use of the technology in a real-world setting and to inspire users and designers to think about new technologies.

By now, technology probes were made only for families, bringing them new communication tools. In this paper, we propose to use a probe in a work context, stressing on its reflexive part and on how to support the advent of new uses of

the system.

We begin by presenting quickly two notions, co-adaptation and interpretive flexibility, which we will use to make a simple way to tailor a system: interpretation. Then we describe how interpretation has been used in practice, presenting our work with biologists and the system done, stressing its flexibility. We conclude by perspectives on how this probe will be used to guide us in the design of the system.

INTERPRETATION

Co-adaptation is an observed phenomenon [3]. A new tool changes his user's behavior by providing him new possibilities or modifying existing ones and, at the same time, the user adapts the system to better fit his expectations, even by unexpected ways. As we want to develop a technology probe supporting the advent of new uses of the system, this probe should be a tool supporting co-adaptation.

Tailorability is the common way to customize a system, the human towards system dimension of the co-adaptation. Mørch distinguishes three levels of tailorability: customization, integration and extension [5]. Customization consists of choosing between different predefined options (preferences); integration is to combine predefined tools together to create new tools (like macros); and extensions consist to add new functionalities (plug-in). We propose to extend this definition with a fourth level: interpretation.

By giving a different semantic to what he is doing, the user can create a new use of a system without needing customization, integration or extension. A good example of what we call an interpretive tool is a spreadsheet. It provides a few elements: lines, columns and a scripting language to apply formulas. And it's the user who decides what the meaning of the table is: accountancy, timetable...

Orlikowski has established that there is flexibility in how people design, interpret, and use technology [6]. This interpretive flexibility is influenced by characteristics of the material artifact (hardware and software), characteristics of the human agents (experience, motivation...) and characteristics of the context. What we call interpretation in this paper can be viewed as a small part of the interpretive flexibility: how the user interprets a technology. And we will try to support it while acting on the material artifact, on the software more precisely.

If the system is semantically charged, it's difficult to apprehend, it can cause many misunderstandings. That can be

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seen like an interpretation, but to use errors as component of the system seems risky. We preferred to go in the other direction and to have a system very simple to apprehend. Thus the user can understand how it functions, making modifications simpler. But attention should be paid has not to simplify the system too much, if not, it will not do anything. The problem to apply interpretation, is to make a system, which is not too much charged with sense, to allow its user to add the semantic, but nevertheless, provides an easy to assimilate basic semantic.

Our probe must be a simple system. To encourage interpretation, the probe does not do anything as long as the user did not start to interpret the system. Thus, when the user will be confronted with a problem, he will be incited to try to modify it. And even if he doesn't reach to do what he planned, he will remember that he tried. An interpretive tool incites its users to reflect on their use of the tool, which is one goal of the technology probe.

INTERPRETATION IN PRACTICE: THE I-BOOK

Context

Biologists use computers more and more in their work: for heavy analyses or comparisons of ADN, to find papers or any information about their work and many other uses. At the same time, they have a significant use of paper laboratory notebooks. These notebooks are almost their physical memory [2]. All their work is transcribed there: the description of the protocols which they follow, obtained results, analysis of these results and almost all things related to their work.

Completely computerized notebooks exists but they are not used by the biologists. The obligation made by the Institut Pasteur (for legal reason due to patents) can seem to be the reason for it, but university biologists, that are not constrained, use still paper book, and the majority of the biologists interviewed at Institut Pasteur doesn't feel it like a constraint. They evoke the facility of editing paper (annotations, diagrams, sticking...), and that notebooks are light and can be used everywhere as opposed to the computers, cumbersome and not very handy. They often evoke their fear of losing their computer's data, by inadvertency or following a breakdown.

The paper notebooks have their advantages, but real problems too: searching and sharing information. This is why our work was immediately placed within the framework of Mixed Reality, keeping the notebook while increasing it with computerized capacities [4].

As it was tell, the main problem with paper notebook is to find information. It is partially due to the fact that all the notes are written chronologically whereas researches are carried out by topics. One of the principal reports from the interviewed biologist is that, even if their problems are similar, each uses a personal way to regulate the problem. Some duplicate important information in many places, other use color categories to have a thematic quick view of her notebook, what some do with bookmark...

A notebook is a very flexible tool, so each biologist has his own practices to work with. For each biologist can keep or create his own practices of work, our goal making this probe

is to provide a tool as flexible as paper notebook, which, moreover, permits to have a digital copy of the contents of the notebook, structured so as to facilitate later researches. For this, both physical and semantic flexibility were explored.

Physical Flexibility

We are using the Anoto Pen in this probe. For the user, is quite like use a normal book and a normal pen, except that he can decide to transfer all that he has wrote to his computer. We can then recover each stroke made on each page of the book, what makes it possible to obtain a digital copy of the contents of the book, stored in a XML file. Obviously, this file does not contain text but all the strokes made on the book, arranged chronologically, which makes it possible to build an image of what was written.

As we wish to facilitate the search in the notebook, we give to the user the possibility to indicate areas of his book, which will be simpler to find afterwards. The meaning of these different areas will be chosen by the biologist, it's the interpretive side of the probe which will be discussed in the next section.

The main inconvenient in the use of the Anoto Pen is the fact that strokes are not send to the computer in real time but in an asynchronous way. So the feedback on what the system understands can't be in real time. Any error of interpretation from the system will be very tedious because indicated a long time after its physical appearance.

To avoid this problem, the interpretation of the interaction with the paper is very robust. We allow a great number of styles of selection. It can be done by underlining the words to select. The same method can be used to select sentences by a vertical line. The selection can also be a shape which includes the selected area or two corners to indicate a rectangular shape. The selection can even be implicit, in this case, the selection is found by means of temporal information.

How to differentiate a rectangle drawn on the book from a selection box or where to seek the implicit selections? In fact, the semantic of a selection is made by 'clicking' (in fact drawing a small mark) on a physical button drawn on one page of the notebook or on a loose leaf. So a selection is always preceded or followed by a click on one of these buttons. A click (which is a stroke on a specific place of a specific page) being very simple to find, selections can then be found simply right before or right afterwards.

When we recover the data of the pen, the system can divide them into click on a button, selection on the notebook and the contents of the notebook, which can then be structured following the selections that the biologist made.

Semantic Flexibility

The semantic of a selection is made by 'clicking' on physical buttons. But to permit interpretation from the user the semantic of a button is made by the user himself. When he creates a new button, he can choose among three kinds: *category*, *title*, or *link*, each involving a particular visualization. It's the basic semantics of the probe.

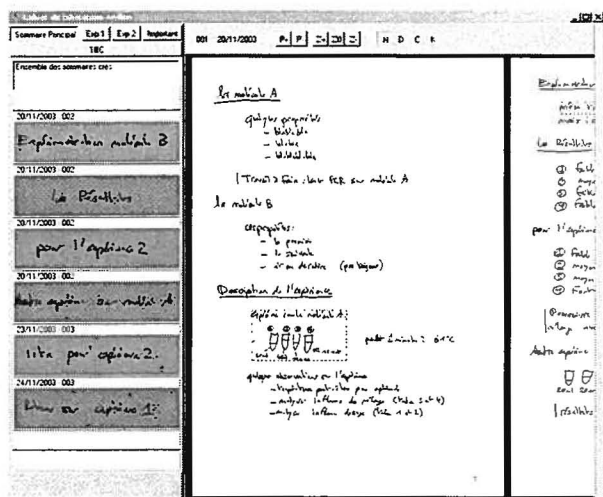


Figure 1: the online side of the I-Book.

Links are used to connect two parts of the notebook. In the online version of the notebook, the *links* are visually distinguished from the non-linked text (framed in green in the figure 1) and they can be followed by a mouse click. *Links* are the first method to structured the notebook and facilitate the research of information

Categories are used to build appendices. Visually, they are represented by a list of all the elements belonging to these *category* (the list is on the left in figure 1) with a system of link between each element of the list and the corresponding place in the notebook. *Categories* can serve to construct appendices, for example a *category* can list all appearances of a certain molecule, which we will call M, in the notebook. If the user filled correctly this category, it can be used like a response to the request: find the molecule M.

Titles are rather similar to *categories* but they permit a stronger structure of the notebook. In fact, all the space in the book between two *titles* is considered to belong to the first *title*. If you create three *titles*, the notebook is cut out in parts belonging to one of this three *titles* and the notebook can be visualized partially, showing only parts belonging to one of those *titles*. The *titles* are employed for reference in the long run, as it is necessary for the experiments which extend over several weeks or months.

These three semantics were selected following the interviews and brainstorming carried out with biologists, and trying to minimize the number of preset semantics. All the biologists want to traverse to them notebook by experiment. The *titles* are well adapted to fragment their book by experiments. They want to reach the various places mentioning a given protocol, or following the various experiments made on a given molecule. That is allowed by the *categories*. It is here the aspect most easily interpretive of the system. It can replace bookmarks, classification by color codes, appendices of protocols, appendices of diagram...

The I-Book, for Interpretive Book, is a tool easy to use because similar to a normal book. With the help of a light extra work which consists to indicate, directly on the book, interesting zones (which was sometimes already made by biologist), it makes it possible to structure the notebook to

facilitate futures researches on it. Thanks to its interpretive side, it permits to each biologist to keep or create his own practices of work. Moreover, like it was suggested in the presentation of interpretation, the probe does not have any button initially, in order to force the biologist to have a thought on its work, on which needs he has.

PERSPECTIVES

The I-Book functions permitting to its user to structure his notebook using buttons. When he creates a button, in addition to specifying its semantics among title, category or link, he is invited to make a textual description of it on his computer and has to draw the button on one of the sheets of the book. The fact of having to create the button and to draw it, it's a good means for the biologist to remember the meaning of the buttons created. This textual description will be useful at the time of the sharing of button between biologists and like return towards the developers.

A true evaluation is envisaged, but there remain some problems to be regulated. Due to its robust recognition, no correction is possible for the moment in the online copy of the notebook. That must be to add to the system before a real use. Moreover, what we wish to see emerging, it's the appropriation of the system by its user, who will model it actively. The appearance of this co-adaptive process and the fact that the tool suggested is used to visualize and to seek information in the notebook, suggest carrying out experiments on the long term, which is not possible at the Institut Pasteur, the notebook being used as legal proof. But evaluations will be done with other academics biologists in our University.

The probe was however presented at the biologists having take part in his design. Its flexibility was largely appreciated and some ideas emerged, like being able to combine visualization by *titles* and *categories* at the same time. By letting this book to be used several weeks in academic laboratories of biology, we hope with confidence to collect several other means to make evolve this probe, what we will be able to see in the structures that they created for their I-Book, and while interviewing them about what they could not do.

CONCLUSION

This paper describes how we have create a kind of Technology Probe which can be used in a Participatory Design process to capture, in their real work context, what the biologists want to do with their tool. For that, we introduce the notion of interpretation, a simple way to tailor a tool which moreover permits to the biologist to reflect on his work and its tool during its work.

This work will be pursued, using this probe and trying to find how the biologists can describe them self how to visualize the semantic which they create, moving away from strict interpretation, since they will have to explain created semantic to the machine, but going towards a really co-adaptive tool.

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