A Smooth Bridge from Idea Capture to Communication

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ABSTRACT

Our purpose is to provide a lightweight tool for workgroup participants, which will enable them to capture daily experiences and to communicate their ideas to others easily. Note-taking and presentation are two common and fundamental activities which may be viewed respectively as the capturing of experiences and the communication of ideas. We developed a system named SketchPoint that allows users to perform freeform note-taking, to author and give presentations informally. Our major contributions are characterized as follows: First, SketchPoint organizes freeform note-taking into a unified hierarchical structure. Second, SketchPoint offers a natural bridge between note-taking and presentations. An informal evaluation of SketchPoint gave us positive comments and valuable suggestions for our future research.

Keywords: Pen-based interface, idea capture, idea communication, sketch

1. INTRODUCTION

Note-taking and presentation are frequent activities of knowledge workers. Note-taking is a convenient way to help us capture our everyday experiences and keep them available for later use. Presentation enables us to present our ideas to others for feedback, modification and publication. In a collaborative group, members usually capture work experiences by note-taking and then present their ideas informally to others for suggestions and further development. However, there is no natural and efficient linkage support between note-taking and presentation activities.

In this paper, we describe an investigation into the activities of workgroup participants with particular focus on note-taking, authoring and giving presentations. We introduce a system called SketchPoint which we developed on the basis of these observations. This system is aimed at bridging the gap between experience capturing and idea presenting by providing users with the tools which help them in freeform note-taking and the information mapping from note-taking to presentation which unites these activities in one smooth system.

We interviewed eight people from one laboratory about their practices in note-taking, presentation authoring and presenting. Their notes are invaluable resources for later use. Once they prepare to give presentations to others, instead of authoring from scratch, they usually go over their notebooks and select the relevant notes as resource materials for presentations. Then they transform these materials into electronic slides using slide-customizing tools such as PowerPoint. However, there is an information gap between note-taking and presentation activities and there is no software support to bridge this gap.

Based on the results of our investigation, we chose collaborative workgroup as the target domain. In such a group people are involved in creative knowledge handling and manipulation. They need to frequently capture their work experiences and exchange ideas with others. We constructed a lightweight tool named SketchPoint, as shown in figure 1, for knowledge workers to perform note-taking tasks, to author and give presentations. SketchPoint consists of two parts (note-taking workspace and presentation workspace) that can work independently or in tandem.
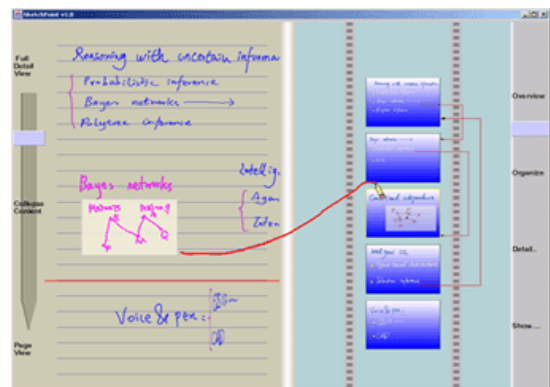

Figure 1. The SketchPoint interface. Note-taking workspace is on the left and presentation workspace is on the right. The user draws a transition stroke to create a slide based on the selected notes on the left.

The process from note-taking to the creation of slides is linked via a smooth mapping function. In the following sections, we firstly introduce the initial investigation which motivated us and gave us basic hints and resources for constructing SketchPoint. Next, we introduce the design and implementation of SketchPoint in detail. The results of an evaluation of SketchPoint are presented. The evaluation gave us great encouragement and implicit guidance for further research. We then conclude the paper with a conclusion.

2. INVESTIGATION

In order to acquire information on the practices on note-taking, authoring and giving presentations, we conducted an investigation in which eight people were interviewed. They all work in a research laboratory. The investigation showed that note-taking and presentation are two fundamental and frequent activities, and it also showed the close linkage relationship between them.

The first interviewee was the leader of the laboratory who had an established habit of writing notes and who frequently gave presentations in and outside the laboratory. The second interviewee was the director of the laboratory who often gave presentations on the progress of each project and on the plans for the laboratory. The third interviewee was a group manager. The forth and fifth interviewees were two senior researchers. They often gave the presentations to the other members about new ideas, research progress or when they encountered difficult problems in their research. The other two interviewees were Ph.D. students and the last was a graduate student. We composed a questionnaire for the interview. The questions related to their practices and their suggestions for both note-taking and presentations. We also studied their notebooks and slides in the light of their explanations of these things and their uses.
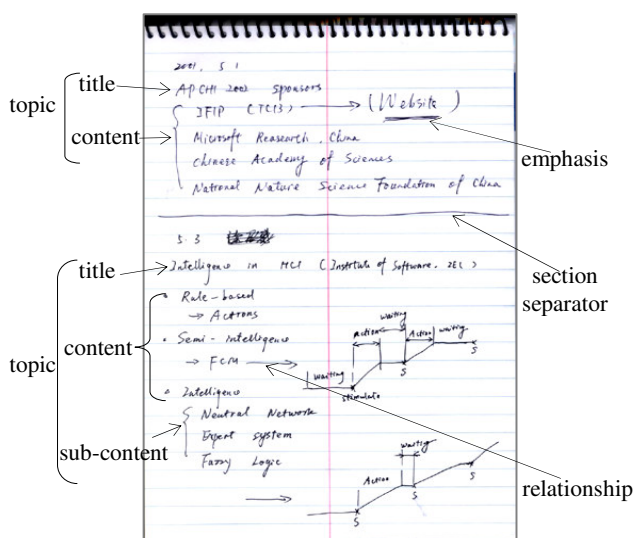

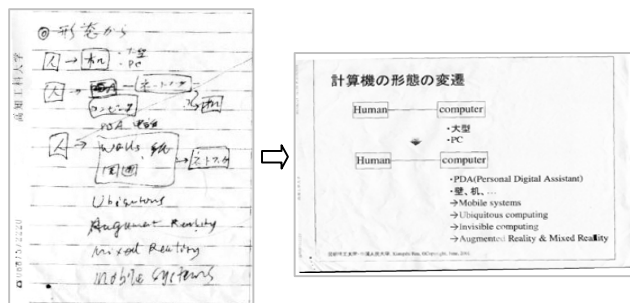**Figure 2.** People use special symbols to organize their notes

Figure 3. One participant authored a slide (on the right) based on the notes (on the left) sketched before.

Our purpose in investigating note-taking was to find out how people write and organize their notes when they use pen and paper. Most interviewees write notes to fulfill brainstorm, to capture important events, to make schedules, or to create reminder prompts. Generally, they can't pay much attention to the careful organization of these notes because they have to write quickly and randomly. Instead they use a set of informal and concise symbols to organize their notes as shown in figure 2.

In figure 2, a large bracket presents a list of sub-level topics and a triangle-shaped symbol at the beginning of a note denotes an item in a list. Underlining (some other participants use star-shaped symbols) is used for emphasis. An arrow indicates a relationship between two blocks of notes or further explanations. A long horizontal line stands for a separation between different sections.

SketchPoint utilizes the affordances and concise efficiency of those organizing symbols and spatial relationships to structuralize freeform notes implicitly without demanding the user's attention or interrupting the user's freedom [5]. Besides, SketchPoint provides a set of basic functions, such as "select", "delete" and "undo" which enable the user to make easy corrections.

In this investigation, we also intended to find out how people author their presentations and what methods are commonly used in customizing slides. The study showed that the presentations of workgroup are highly dependent on their notebooks. Most of the interviewees think that their notebooks are great resources for authoring presentations. Three interviewees showed us their slides and the original materials for these slides in their notebooks. One sample is shown in figure 3. We asked

them to interpret the process by which they completed this task. Generally, they choose the related materials and transcribed these materials into a computer using electronic authoring tools. SketchPoint provides an automatic and smooth mapping from note space to slides.

We also realized that, in a workgroup in-house slide presentation, the important thing for the members is not to make a formal, exquisite slide presentation. Instead, they prefer to easily and quickly publish their ideas to others, to exchange information and views with others and get more suggestions in early stage of research work. SketchPoint enables workgroup people to customize informal slides by sketching instead of re-implementing all the functions of other formal presentation authoring tools.

3. RELATED WORK

Several studies have been done under whiteboard metaphor for workgroup meetings or experience capturing in office work [7][8][11]. By contrast, SketchPoint is based on the notebook metaphor and is designed to enable users to capture daily experiences by using freeform note-taking. Furthermore it enables them to communicate their ideas to others easily in easy-to-prepare informal presentations. The bridge from individual experience capturing to idea presenting is greatly emphasized by SketchPoint.

To achieve a low cognitive load for users, SketchPoint allows users to sketch notes in a freeform manner, which means that anything can go anywhere without constraint. In recent years, the trends not to process the ink or to process the ink internally while displaying the unprocessed ink have been applied in many research systems [2][6][7][8][9][13]. SketchPoint keeps the sketched notes unrecognized and structuralizes free notes implicitly [5].

The metaphor of zoomable user interface [1] is used by SketchPoint in note-taking to present a collapsible, hierarchical and structural view of notes to users. SketchPoint also employs zoomable user interface to unify the organization, detailed edit and final show of slides in the presentation workspace.

The Palette [10] is a digital appliance designed to help presenters give presentations. Influential commercial products such as Microsoft PowerPoint focus on the creation of polished formal slides. MultiPoint [12] implemented as an add-on to Microsoft PowerPoint enhances PowerPoint with multimodal interaction, i.e., pen and voice. However, SketchPoint employs sketch-based interaction techniques (Sketching has been widely used in GUI design [5], web site design [6] and other research areas [4]) and focuses on informal presentation design and final show. In addition, in order to ease the information transmission from note-taking to presentations, SketchPoint provides automatic mapping from freeform notes to informal slides. The storyboard design metaphor has been used in GUI design [5] and website design [6]. We applied the storyboard metaphor in presentation design to enable users to sketch the sequence and hyperlinks between slides.

4. THE SKETCHPOINT SYSTEM

SketchPoint was built in Java 2. SketchPoint consists of two workspaces for note-taking and presentation respectively. As shown in figure 1, both of them are equipped with zoom sliders allowing users to zoom to the desired level. The bright bar separating two workspaces can be dragged horizontally to adjust them to the appropriate size. Note-taking and presentation are two independent features of SketchPoint, however, the bridge between them is an important feature of SketchPoint.

4.1. Freeform Note-taking

SketchPoint is designed to allow users to write and draw freely. The notes sketched by users might include words, graphs, special symbols for structuralizing or meaningless doodles. A better structuralization of these free notes is important for further manipulations, such as select and edit. The structuralized notes are easily maintained, manipulated and reused later.

SketchPoint organizes free notes into the structure of figure 4, which a notebook might include multiple sections and each section can include several topics. A topic is organized as a title-content structure [5]. Here, all sketches are treated as simple strokes except those for ink structuralization and editing. We summarized those organizing symbols of traditional note-taking and abstracted a set of gestures as in figure 5. Using these gestures, the freeform notes can be organized into a hierarchical structure of figure 4. Most gestures here are recognized internally and keep their appearance

unprocessed, which results in low cognitive load to users. And user also can undo the manipulation by pressing the button on the side of pen.

By default, there is only one section in SketchPoint, which logically has unlimited size for drawing and writing. The user can draw a section-breaking gesture (i.e. a long horizontal separating line) to split a section. The separation line between sections is a horizontal straight (red) line running through the section, as shown in figure 1.

SketchPoint organizes notes into a hierarchical tree-like structure in which the root node is the notebook and the leaves are strokes. In this way, SketchPoint can bring several advantages to users.

First, SketchPoint presents a collapsible and zoomable view of notes. By dragging the elevator of zoom slider (on the leftmost of figure 1) top-down, the user can collapse notes gradually while zooming. In full detail view, all topics

Figure 4. The structure of the SketchPoint notebook

are completely expanded. During dragging down, more and more sub-level topics are collapsed. To certain extent, only the titles of first-level topics appear on the page. Finally, there are only section views. By zooming the notes to the appropriate detail level, users can easily find the desired topic. By choosing the zoom center and zooming in or out, users can efficiently and naturally navigate in the notebook.

According to the layout of each topic or subtopic, there are two kinds of collapsing styles. If a topic has the top-bottom layout, its content will be collapsed vertically with regard to its title. If the topic follows the left-right layout, the content will be collapsed horizontally. When a topic (with sub-level topics) has both layouts, it will conduct compound collapsing.

Second, by enhancing ink grouping with the structure semantics of notes instead of using the spatial and temporal distance only, users can more efficiently select the desired notes. For example, selecting the title of a topic will cause the whole topic including its content and attached sub-level topics to be selected. Similarly, erasing the title of a topic (using the "erase" gesture in figure 5) will remove the whole topic. The title-content structure maintains the correlation of notes which reduces the effort needed to discern the relationships between these notes.

In SketchPoint, users can select the notes by "holding" or "continuously taping" the pen on the target notes. A "hold" event is triggered by pressing the pen tip on the tablet for a short interval (2.0 seconds) and is terminated by releasing the pen from the tablet. The "continuous tap" method means repeatedly tapping the pen on the tablet with less than 1.7 seconds between taps. The time length of the "hold" or the number of taps in the "continuous tap" method determines the factor of selection expansion (e.g., If you have already selected a title by several taps, a more tap will cause the whole topic of this title to be selected). The selection expansion within a *strokeblock* depends on the distance of the stroke clusters. However, outside the *strokeblock*, selection is expanded according to the structure of the notes, e.g. in figure 4, the selection will be expanded bottom-up from the leaf (i.e. *strokeblock*) to the root node (i.e. notebook). In this way, the user can rapidly select notes at any level from a single stroke to the whole notebook.
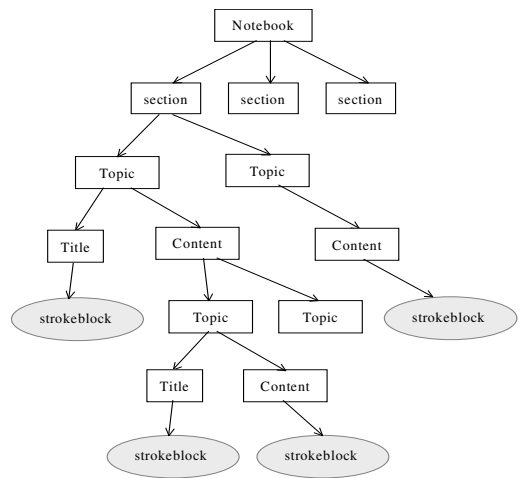
4.2. Sketch-based Presentation Authoring and Presenting

SketchPoint allows users to author and give presentations informally by sketching. SketchPoint unifies various design and presentation activities by zooming. SketchPoint employs a storyboard to specify the sequences and hyperlinks of slides. In the "Overview" level, the user can delete a slide by dragging it away from the storyboard or the user can adjust its sequence by dragging it backward or forward in the storyboard. Rough views of slides are shown in this level. When zooming to the "Organize" mode, the user can create a hyperlink by drawing a
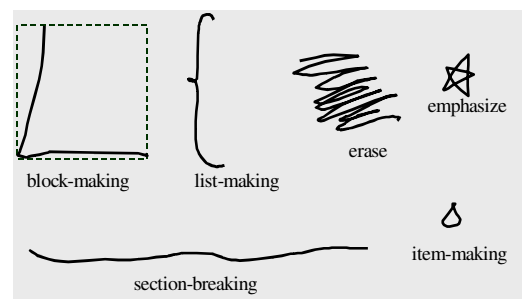

Figure 5. Gestures used by SketchPoint for ink structuralization and manipulation

linkage line from a piece of content in the source slide to the target slide. The content of a slide can be edited or sketched when zooming to the "Detail" mode. A user can select any slide as a focus slide by drawing a loop around the slide. Thus the focus slide will be the zoom center. When the user zooms the interface to "Show" mode, the focus slide will be projected to the full screen and the user can deliver the actual presentation. Users can tap the pen to bring up the next slide (tapping on a hyperlink will bring up the target slide of this hyperlink) or trigger a double-tap to back to the previous slide. If the user wants to end the presentation, she/he can trigger a "hold" event to stop the presentation and go back to the detail mode. SketchPoint allows a user to annotate the slide freely when giving the presentation. This is quite important when giving an informal presentation where colleagues can offer more detailed interactive discussions.

Through the study, we found that note-taking is an important preparation for authoring a presentation. By organizing their notes and selecting the desired contents, people present their ideas, captured in daily life, to others. In this process, because their ideas generally are not mature and they need discussions and suggestions, they don't wish to use formal authoring tools because these tools demand that much attention be paid to attractive layout and other details. Instead, the study showed that, besides using slide presentations, they sometimes transcribe the desired contents to a whiteboard manually. There is a lack of efficient software support to bridge the gap between note-taking and presentations.

In SketchPoint, besides using "insert" gestures in the presentation workspace to create slides, the user can also pick the notes in SketchPoint notebook to construct the slides. As shown in figure 1, SketchPoint provides an intuitive way for users to map the note materials in the note-taking workspace to the slides in the presentation workspace. Users can look for and choose the desired materials in the note-taking workspace by zooming and selection, and then draw a transition line to the presentation workspace. Consequently, the corresponding slides will be created and arranged in the storyboard.

5. A TYPICAL CASE OF SKETCHPOINT USE

In order to clarify how people use SketchPoint in their daily work, we describe a typical scenario in which SketchPoint is used. Tony is a researcher in a research group where a lot of creative work is done. People in this group need to frequently exchange ideas during research. There are both spontaneous and scheduled meetings or discussions in the group. Each person has a SketchPoint system running on a portable paper-like computing device (e.g. tablet PC). Tony always has his SketchPoint system with him and he performs note-taking while reading, in lectures and in other situations. His experiences from work and life are captured in SketchPoint. During this process, he always adjusts the note-taking workspace to occupy the full screen. By zooming to collapse and expand notes, he navigates in his SketchPoint notebook and checks the important events, reminders and other information.

One day, Tony thought he had made some progress but he still had some problems with his research. He wanted to exchange ideas with others. So he started to prepare an inter-group presentation. He browsed his SketchPoint notebook and looked for the related notes. He dragged the separating bar horizontally to leave the appropriate space for presentation workspace. Then he repeatedly picked the related materials in the notebook and transferred them to the presentation workspace. He zoomed the presentation to "Overview" mode to adjust the sequence of the slides and to delete the unwanted slides. He also created some empty slides where he wanted to add some new contents. He sketched the new contents in them in the "Detail" mode. Because some slides from his notes might be illegible to others, he modified them a little in the "Detail" mode. He also sketched the hyperlink relationships in these slides. During this process, he might frequently zoom through the notebook to pick the desired notes and zoom through the presentation workspace to achieve various manipulations. Sometimes, he also dragged the separating bar to adjust the sizes of the two workspaces. When finished, he zoomed the presentation to the "Show" mode to test his presentation. While giving his presentation, he could freely annotate his slides to ensure a clear explanation.

6. INFORMAL EVALUATION

In order to acquire feedback on the usability of the interaction techniques and the functions of the system, we conducted an informal evaluation on SketchPoint. Twelve people participated in this evaluation. Eight of them had been interviewed in the investigation.

6.1. Design of Evaluation

We conducted the evaluation in the Pentium III 800 PC with 17'' display running Microsoft Windows 2000 environment. A Wacom Intuous Tablet was attached, which was 9x12 inches. Because the tablet pen is different from the real pen-

paper mode, we asked each participant to get familiar with the tablet device. Actually, five of them had experience using tablet pen devices. Finally, they were all able to use the tablet pen well. We also showed them a demonstration video of SketchPoint and spent about five minutes instructing them in the use of the system. Then they practiced using SketchPoint for ten minutes.

As the first step of evaluation, we asked each participant to choose a research paper and to take notes using SketchPoint while reading. Then they were asked to use SketchPoint to prepare a presentation about what they learned from the research papers. Finally, five of them gave their presentations using SketchPoint. When they finished, they were asked to answer a questionnaire and rate the functions (mark ranges from 0 to 10, 10 being the best). We also recorded the usage frequency of each function in the system during interaction.

6.2. Results

In the evaluation, we found that the participants like the informal use and interface styles of SketchPoint (9 out of 10). They thought it was quite convenient for them to capture their ideas when reading. One participant said, "I can write freely. There is little limitation to my writing". The participants said that, if the system runs on a paper-like device which is easy to carry, they would prefer to use it in daily work.

Participants rarely used section-breaking gesture (use frequency averaged 0.83 per person) and it got a mark (7.12 out of 10). The "erase" gesture got a good mark (8.6) and participants thought that it was convenient to make correction. The "item-making" gesture and "emphasize" gesture got low mark (4.6 and 5.0 respectively) because they were unstable to use. The rating for the block-making gesture was normal (6.1 out of 10). They suggested that an irregular block area for the block-making gesture would be more flexible because it would allow them to make better use of the space. Most participants thought the list-making gesture was intuitive (8.7 out of 10). One participant suggested that when grouping the notes implicitly, some more feedback would be helpful. The collapsible and zoomable view of notes got a high mark (9.7 out of 10). All participants used zooming to collapse and expand notes a lot. They thought this function made it easy to find their wanted notes. The structuralization of notes really saved a lot of effort when picking a group of related notes. The study showed that, in making a selection, the participants preferred the "continuous tap" over "hold" (about 96.4%) because they thought that the surface of the tablet was too slippery to trigger the "hold" event.

The observations showed that the participants authored their presentations quite quickly. They authored about 6 to 10 slides in a short period ranging from 3 to 6 minutes. And most slides (average about 81.0%) were created from notes in the note-taking workspace. To achieve this they just needed to pick the content and draw a transition stroke to the presentation workspace. The function which bridges notes to slides was considered to be quite attractive and useful (9.6 out of 10). They thought SketchPoint really met their requirements in their inter-group presentations. One participant said, "I can prepare my presentation just 5 minutes before a meeting". During authoring, they frequently zoomed to different zoom levels. They thought zooming in the presentation workspace provides a unified design process from the organization, detailed editing on to the final presentation (7.9 out of 10). They preferred to use the storyboard to adjust the sequence of slides and to create hyperlinks between the slides (7.7 out of 10). All five presenters gave fluent presentations. They thought that sketching on the slide like a whiteboard made it easier to convey their ideas to others (8.6 out of 10).

7. CONCLUSION

We designed SketchPoint to allow a user to perform freeform note-taking, to author and give presentations informally. An important feature of SketchPoint is that it allows a user to choose materials directly from their daily notes to construct the presentation slides in a smooth way. So a bridge from daily experiences to presentations is established. An informal evaluation of SketchPoint showed that it was accepted by the participants and that they thought it would be helpful in their work. The evaluation also gave us some suggestions for our future work.

ACKNOWLEDGMENTS

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