Visualizing Discussion History

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ABSTRACT

The current systems supporting computer-mediated discussion usually provide only a strict hierarchical structure for the annotations of a discussion. Applying existing visualization techniques can be used for allowing a more free and natural structure of annotations. GraffiDis is a discussion system supporting computer-mediated asynchronous and synchronous discussion. The discussions conducted with the system consist of graphical annotations including text and graphical elements. The history of the discussion is visualized by fading the older annotations to the background of the discussion. Using a simple slider a user can browse the history of the discussion forwards and backwards. This article describes the system and the visualization technique with the aid of two sample discussions. Based on the experience on the use of the system it is attested that GraffiDis is especially suitable for conducting discussions with a clear target to discuss about provided in the form of a background picture.

Keywords

Groupware, visualization, discussion tools, fading

1 INTRODUCTION

The explosive growth of the Internet has brought along a large variety of programs that enable distributed group conversations over the network (Woolley). Only few of the systems have been successful enough to gather a user group large enough for the systems to be profitable. We are attacking this problem from the point of view of information visualization. Almost invariably, the annotations of a discussion are arranged in a strict hierarchical structure. This structure is also the underlying mechanism in presenting the discussion to the user. The existing visualization techniques can provide better ways for the presentation.

We have created a discussion system *GraffiDis* that allows annotations to be placed freely in a 2D-discussion area and uses fading for visualizing the age of annotations (Patent pending, Finnish patent application number 990321).

One of the initial requirements for a management information system called IMIS (Käki *et al* 1998) was to provide tools for collaboration. There was a need for a system supporting discussion *among* the users of the system *about* the data presented by the system. The discussion was to be held *inside* the actual system.

The users of the system did not seem to be very enthusiastic about the current text-based discussion or conferencing systems. They needed a more straightforward way for creating annotations and conducting discussions about the data provided by the system. In addition, they did not particularly like to be forced into an elaborate hierarchical structure. See Shumner and Buckingham Shum (1998) for similar findings.

A promising approach seemed to be using a shared drawing (Greenberg *et al* 1995) for conducting the discussions. In shared drawing we could start with a visual report of an interesting collection of data and continue by drawing annotations on top of the report. However, the shared drawing systems are mainly intended for synchronous communication and design tasks but in IMIS the emphasis is on asynchronous discussions.

Therefore, we decided to create a somewhat different system. The basis of our discussion system is a shared drawing. Thus, it is possible to position the annotations (including graphics) freely in the discussion area.

Furthermore, to provide the users a clear view on the evolution of the discussion and to prevent the discussion area from getting full we fade the annotations gradually to the background of the discussion. We also provide a history slider for changing the view on the discussion backwards and forwards in time.

In addition to the implementation of GraffiDis as a subsystem of IMIS, we have also created a separate discussion system. This system has been used for several months for some serious and not so serious work. The sample discussions described below belong to the more serious set of discussions.

In this article we shall first take a look at the related work on visualization especially in groupware applications. After related work, we shall see a short description of the visualization technique used in system along with some theory behind the technique. Next we shall describe the GraffiDis discussion system and two sample discussions.

2 RELATED WORK

There are some examples on using fading or semitransparency in user interfaces. Wong (1993), and Genau and Kramer (1995) use semitransparent layers for presenting different versions of the same document in the same display area. Cox *et al* (1997) use a transparent overview layer on top of a detailed view to help navigation in a document. The tools described by Wong, and Genau and Kramer are very similar in nature and very much related to our system. Still, they do not consider the temporal ordering of the layers as an important aspect of their studies. And more importantly, their systems are not used for collaboration.

Hill and Hollan (1992) introduce a thing called computational wear for user interface components and document objects. Their research provides valuable theoretical background and experience on presenting real-world qualities like wear and, for instance, age by manipulating the visual attributes of a user interface component.

In groupware systems there are only a few examples on using any special visualization for presenting the temporal ordering of annotations of other elements used for collaboration. Ellis *et al* (1991) use bright blue color for indicating changes in their prototype group editor Grove. The color gradually changes into black during time. The colors are used solely for indicating changes in the edited document. They do not, however, consider time itself as a structuring concept.

Edwards and Mynatt (1997) have constructed a toolkit called Timewarp that supports autonomous collaboration (partly synchronous and partly asynchronous) by making the notion of time explicit in the interface of a collaborative application. They have implemented a sample application for creating office layouts. In the application there is a separate acyclic graph view of the timelines (versions) of the created layout in addition to the single view of a selected timeline. Each (major) change to the layout creates a new timeline and a new node in the graph view. It is possible to edit timelines for example by joining them together. If two joined timelines are inconsistent in some way drawing the two timelines transparently can single out the inconsistency. Although Timewarp is used for creating different and apparently more complex applications than our discussion system, their studies provide valuable experience on considering "time as a first class citizen" in structuring collaboration.

Chat Circles (Viegas and Donath 1999) is a chatting program including interesting visualizations in describing the current state and the history of a network chat. Especially, it utilizes size for indicating the most recent annotations and position for indicating the separate chatting groups. Chat Circles supports our point of view on the usefulness of visualization techniques in groupware.

CommunityBoard (Hattori *et al* 1999) includes a system for supporting network discussions. The discussions are visualized in a global view by drawing the title of the discussion along with little pictures of the participants. The color value of a picture indicates the age of the most recent annotation by the corresponding user. Although the technique used in Communityboard is same as in GraffiDis, it is applied to different entities, namely participants, than in our system where it is applied to the annotations.

In our discussion system we provide a slider for moving backwards and forwards in time. In WeMet (Rhyne and Wolf 1992) a similar technique is considered valuable in supporting the process of collaboration.

Virtually all of the separate elements of our discussion system can be found in the previous research. Fading (or dimming or semitransparency) is used for visualizing versions of a document. Time has been used as a structuring concept in a collaborative application. A slider has been used for changing the view of a document in time. Yet, all of these have not been joined together in earlier systems.

3 VISUALIZING THE AGE OF ANNOTATIONS

We decided to use fading (the color value relative to the background) for visualizing the age of annotations in GraffiDis. The initial motivation was given by the excellent catalog visualization for NiF research consortium (Murtaugh). The catalog uses different shades of gray (along with differing font sizes and selection colors) for presenting a large amount of structured textual information in a small space. Murtaugh uses different shades of gray for differentiating between the levels of hierarchically structured information.

It is possible to use a similar technique for visualizing the age of the elements of a set of data e.g. graphical object in a shared drawing. We have found this technique

very useful and easily applicable. But are there other possibilities?

Bertin's (1983) study on retinal variables identifies seven attributes that can be used for visual distinctions. Out of these seven attributes only three are *ordered*, namely, *position*, *size*, and *value*. An ordered attribute reveals the natural ordering of a set of visual elements. As an example consider the set of symbols (letters) shown in Figure 1.

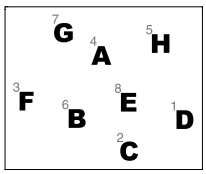

Figure 1: A set of symbols with an unordinary order (presented by the little superscripts).

Figure 2 consists of three different visualizations of the same set of symbols as in Figure 1. Each of the three visualizations uses a different visual attribute for revealing the unordinary order of the symbols. The attributes are (a) position, (b) size, and (c) value (shade of gray). In all of the three pictures, the order of the symbols is immediately obvious. Position gives the most accurate cue on the order. Position and size are also *quantitative*—they permit judgement on the relative difference of the symbols. Attributes size and value are *dissociative* because they will eventually render part of the symbols unreadable.

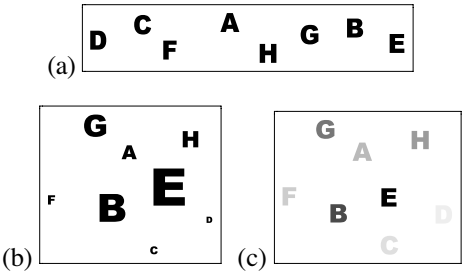

Figure 2: The order of the symbols in Figure 1 visualized by (a) position, (b) size, and (c) value.

We selected letters as symbols for the figures in order to show another aspect of the retinal variables. Notice that although there is another natural or rather cultural order, namely alphabetical, of the symbols, it is not immediately apparent because *shape*, one of the retinal variables, is not ordered. The person viewing the figure must spend some time thinking in order to order the symbols alphabetically.

Recall that our problem domain consists of a discussion in the form of a shared drawing where each annotation is a visual element containing text and graphics. Recall also that we are looking for a way to visualize the age of the annotations. Straightforward application of the three visual attributes to our problem domain reveals that

- *position* cannot be used for indicating the age of annotations because the position of the visual elements is reserved for other purposes,
- *size* could be used if we required that some of the other attributes of the visual elements of the annotations be restricted to similar values (same font size, same line width, …), and
- *value* can be used even if the other attributes of the visual elements are allowed to differ significantly.

This seems to imply that we should choose *value* as an attribute used for indicating the age of the annotations.

There are some problems in using value in this context. The first and most important problem is low accuracy. Value does not allow accurate measurement of the quantity of the difference between two visual elements. Yet, the quantity of the age difference between two annotations in a discussion is not, fortunately, so important that we should reject value.

4 GRAFFIDIS SYSTEM

We implemented the GraffiDis (stands for "Graffitical Discussion") discussion system with the Java programming language using RMI (remote method invocation) for network connections. The system consists of a discussion database server and a discussion client. Here we concentrate on the user interface of the client.

The main elements of the user interface are the *discussion summary window* (see Figure 3) and the *discussion annotation window* (see Figure 4 in next page).

Figure 3: The GraffiDis discussion summary window. The summary window can be used with little thumbnail views of the discussion (lower) or without (upper).

The discussion summary window contains a button for each discussion the user is allowed to participate in. The buttons can contain little thumbnail views on the discussions. The changed discussions (since last viewed) are

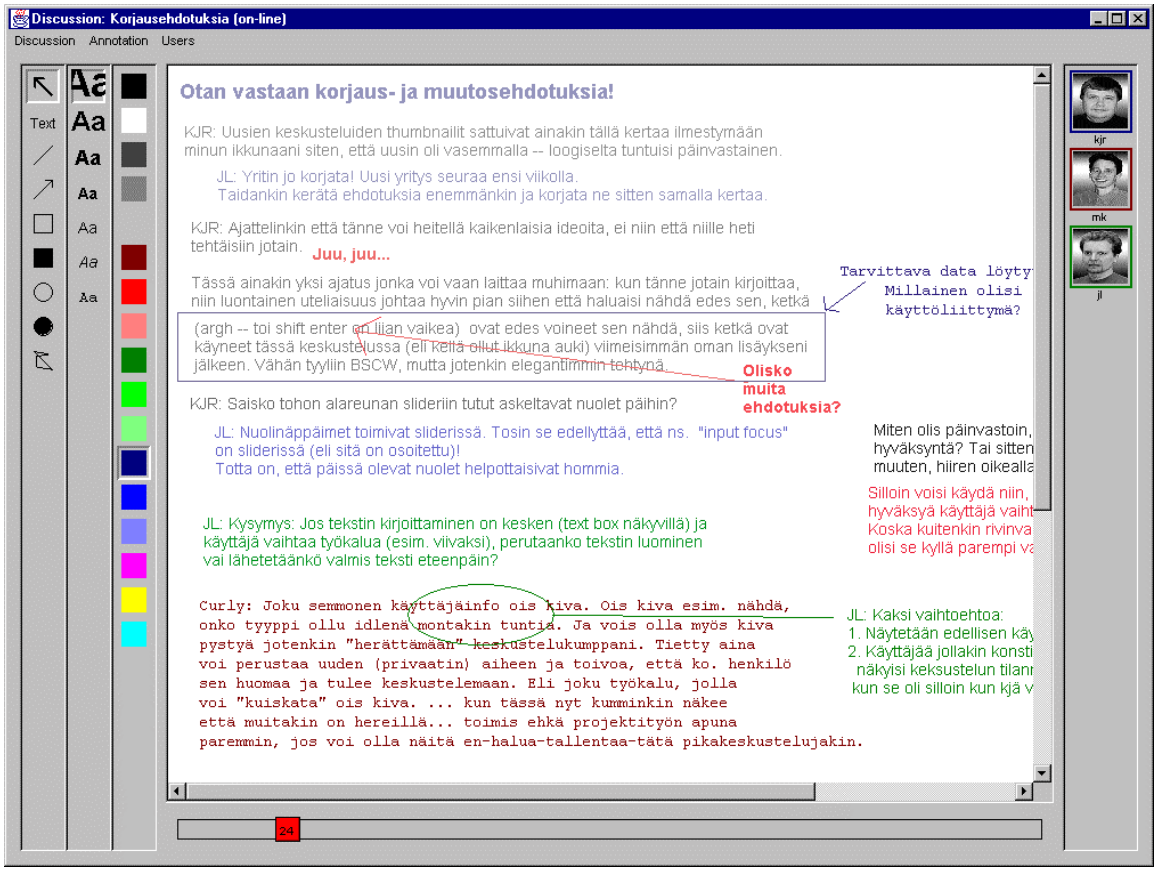

Figure 4: The GraffiDis discussion annotation window. The components from left to right are drawing tool panel, font panel, color panel, discussion area with the history slider, and user panel.

indicated by the color of the title. The user can create new discussions and remove existing ones (those she/he has created) with the commands provided in the summary window.

The discussion annotation window provides a user interface for viewing and annotating a discussion. The central component of the window is the *discussion area*. The discussion area shows a view of the discussion at some point in time. The view can be changed with the *discussion history slider*. The slider controls the latest annotation viewed in the discussion area. The length of the view (e.g. how many annotations are visible) is fixed. See section Future work below for description of an alternative slider allowing changes in the length of the view.

The discussion annotation window provides the usual drawing tools making it possible to draw text, lines, arrows rectangles, ovals, and free lines. It is also possible to change the color of the graphical elements and the font of the text elements. We did also include a *remote pointer* for the casual synchronous usage of the system. The remote pointer has not actually been used very much due to the asynchronous nature of the system and we shall probably omit it from the future versions of the system.

The discussion may contain a background picture. This can be used in specifying the topic of the discussion by giving an artifact to discuss about. Indeed, the most successful discussion usually included a background picture. The background picture is always visible in the discussion area.

The user panel shows the names and portraits of *current* users, that is, the users that are currently participating to the discussion. The panel can be set to show other (not currently participating) users as well. Currently, the user panel has no other functionality.

5 SAMPLE DISCUSSIONS

Three project groups and a number of other people in out academic environment have used our discussion system for serious and not so serious work-related communication. Most of the discussions were conducted by a relatively small group of people usually about three users actively creating annotations. We shall take a look at two different types of discussions. But before that, we shall list a few general findings about the system.

5.1 General findings

The discussions conducted with the system could be interesting from the point of view of *conversation analysis* (See Future work for additional details). However, lacking experience (and experts) in sociology, we have tried to

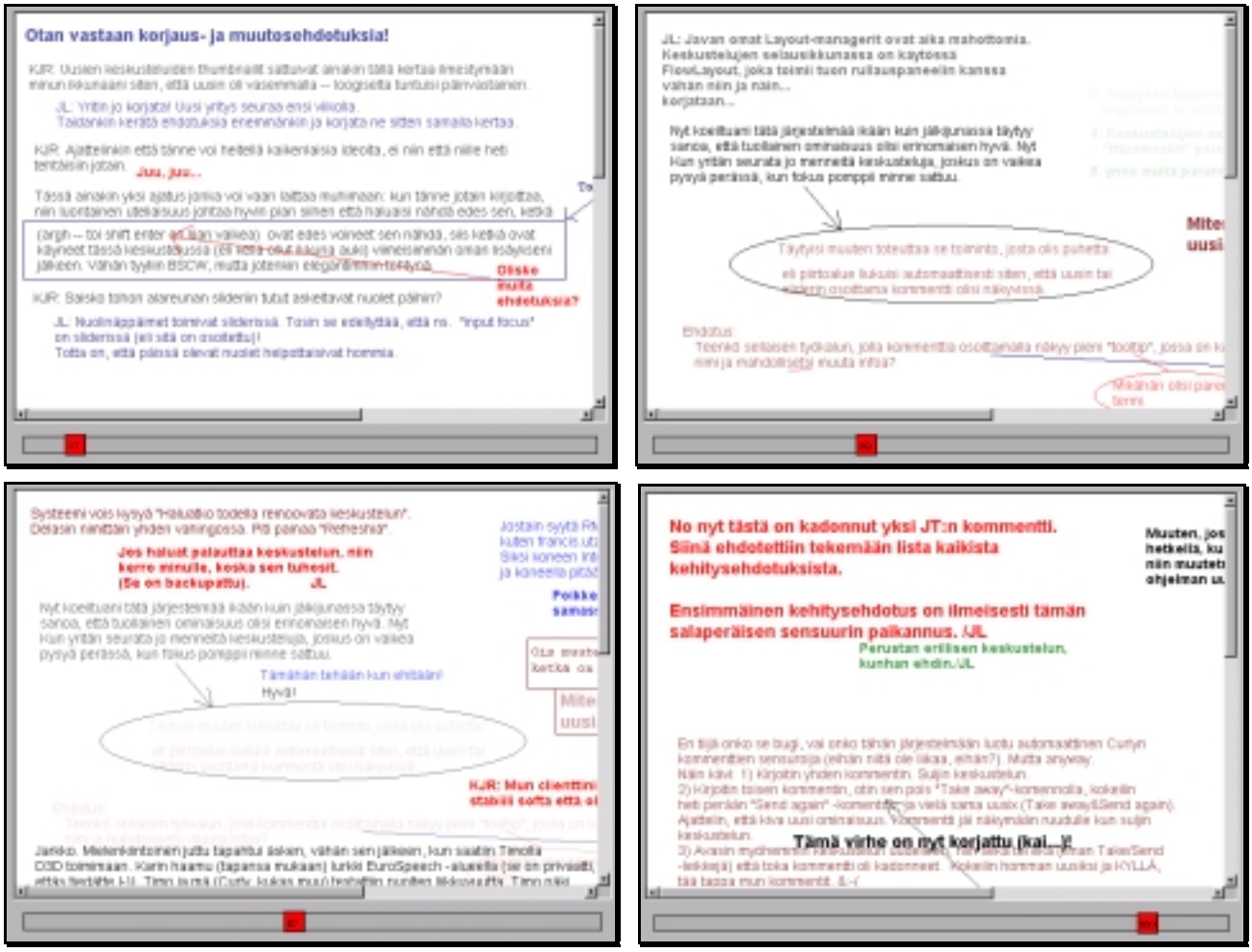

Figure 5: A view on a "bugs and improvements" discussion. Several different ways for referring to older annotations can be seen in the views.

find aspects of discussions related to the visualization system.

Scalability of the system for large discussions has been a great concern during the development. It might seem that the eventual disappearance of the older annotations poses a problem if one wants to refer to one of them. Currently we have experience of discussions including up to 400 annotations. These cannot be called very large discussions. Nevertheless, we can safely say that at least for discussions with that size the scalability is not a problem. In addition, the nature of the discussions is such that people rarely need to comment on the older annotations. Remember that in order to view the older annotations, one has only to use the slider provided in the system.

In analyzing the discussions we were especially interested in the positioning of annotations relative to their target annotation. Our initial assumption was that because the system allowed free spacing of annotations, the users would position the annotations anywhere near the target. This was not, nevertheless, usually the case. People tended to position the annotations mostly to the right and downwards from their target. Yet, the positioning did not always follow the normal direction of text and the users did use several methods for referring to other annotations.

5.2 Non-focused discussion

We picked two sample discussions for more detailed analysis in order to get a more clarified view on the nature of the discussions. The first discussion is non-focused, that is, consist of several small threads related but not aiming at a same goal. The other one is a more focused discussion with a clear task. The discussions are in Finnish.

Figure 5 shows four views on the bulletin board discussion (see also the larger picture in Figure 4). The discussion was about the actual system itself. It was meant to be a free-form discussion about the bugs and improvements found by the users of the discussion. It is a fine sample of a group of non-focused discussions conducted with GraffiDis.

The overall structure of the discussion consisted of small threads including and annotation including a question or a

comment and from one to about three or four comments. The users usually created the comments quite promptly after the initial annotation. In about day or two the thread was completely finished. Only rarely did the users refer to the older annotations.

The annotations were almost entirely textual. The users made use of the graphical elements only for strengthening the reference to the target annotation.

As stated above the visual structure of the discussion followed mostly the common arrangement of text-based information. Users positioned comments downwards and to the right of their target. However, if several comments have the same target their positions were chosen in a more free fashion.

The greatest problem found in this type of discussion was in locating the newest annotations on the discussion area. We did not implement automatic scrolling of the discussion area. It is evident from the comments given by the users that automatic scrolling should be used for pointing out the newest annotations when sliding the history slider.

Sometimes, users would have liked to adjust the number of the visible annotations. They felt that the speed of fading was maybe a little too fast. Actually, the speed is a compromise between the amount of visible information and the amount of empty space. Users rarely created new annotations on top of the older annotations. Thus they would run out of discussion area if the speed of fading were slow. In spite of that we see no reason in letting the users make adjustments on the discussion view, even the number of the visible annotations.

The visualization technique did seem to work quite well in this type of discussion. The fading created enough space for the new annotations and the overall size of the discussion area did not grow too large. The users reported using the history slider for quick browsing through the

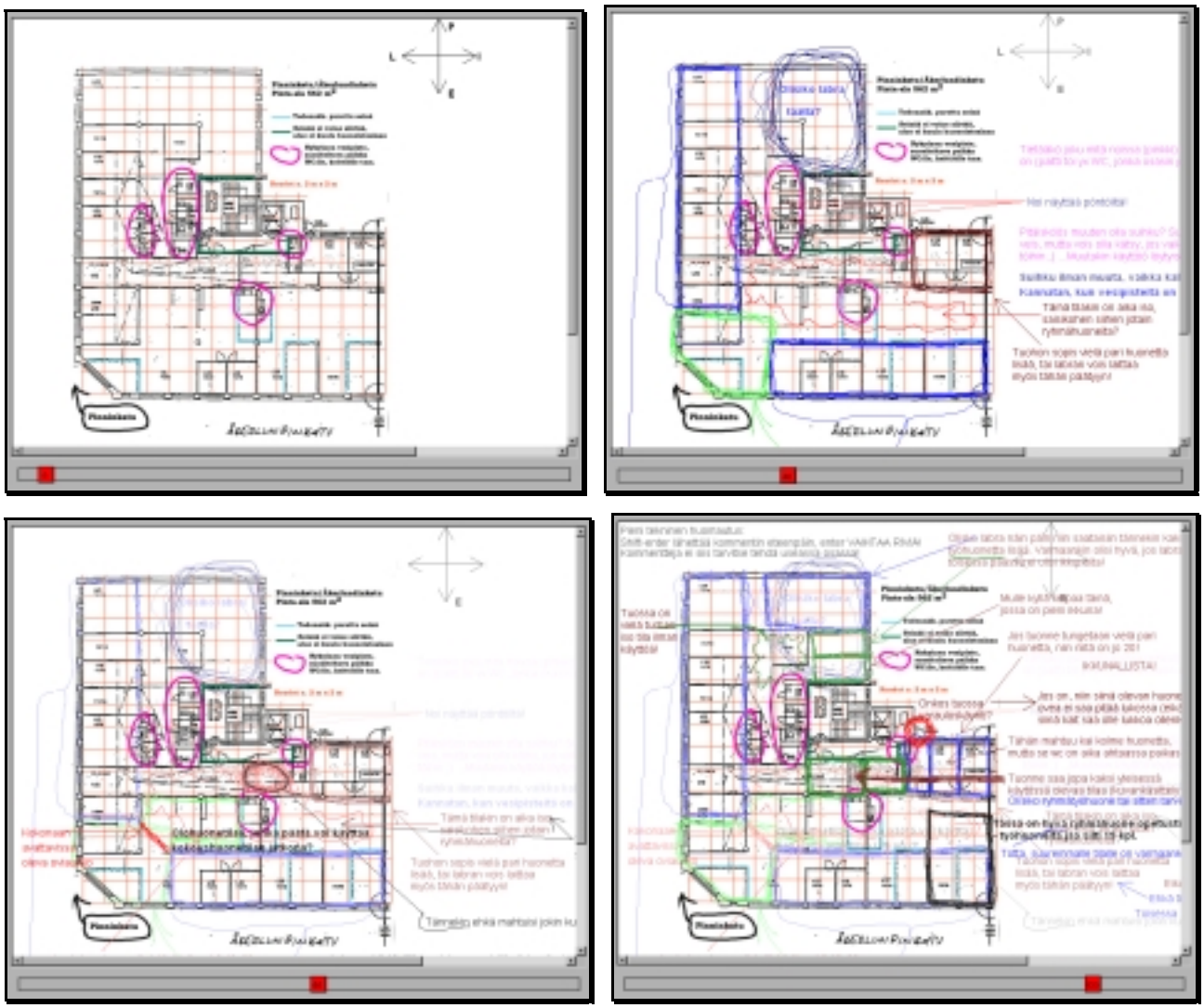

Figure 6: Four views on a "floor planning" discussion. The discussion started with an initial floor plan provided as a background picture.

newest annotations.

5.3 Focused discussion

Figure 6 shows four views on a focused discussion with a clear goal. The discussion was created for planning the usage of the new office space of our research group. The discussion started with a background picture describing the existing floor plan of the new office space along with some initial comments.

The discussion is one of the several discussions with an artifact to discuss about. .In addition to the one described here, we conducted similar discussions about user interface design and logo design just to name two examples.

Most of the observations about a non-focused discussion apply to this type of discussion as well. There are some natural differences in the way the comments are positioned on the discussion area. The target for a large number of the annotations was the background picture, thus they were positioned near the picture.

There were two main classes for annotations. About half of the annotations included a drawing on top of the floor plan and a textual comment positioned at the side of the floor plan. Rest of the annotations were purely textual comments on the other annotations.

We were quite surprised about the fact that users were quite shy in creating annotations on the top of the picture. We suspect that they didn't take the fading into account when creating annotations. Even the unsuccessful comments will, indeed, fade into the background and leave room for new tries.

The visualization had an interesting effect on the structure of the discussion. As some of the annotations with concrete proposals faded to the background, the users started to refresh them by drawing parts of the proposals again. It seemed a bit awkward at first, but very soon we noticed that only those proposals were refreshed that were given support in the discussion. Thus, the fading effect quite naturally formed a basis for measuring the support given for the proposals.

However, in examining the other discussion as well we noticed that it should be possible to create *persistent* annotations, or rather, change the persistency of existing annotations. A persistent annotation would not fade into the background.

Again, GraffiDis suited quite well for this kind of discussions. Actually it works better with discussion with a clear artefact to discuss about. With a restricted possibility of creating persistent annotations, GraffiDis could be very successful with the type of discussions this one represents.

6 FUTURE WORK

The users of GraffiDis have given many interesting proposals for the improvement of the system. The most interesting proposals are about controlling the view on a discussion. We have implemented a new kind of slider allowing users to change the number of visible annotations (see Figure 7). The slider consists of two parts: the *tail* controls the number of the faded annotations; the *head* controls the number of the other visible annotations. We have included the slider into a forthcoming version of GraffiDis but do not have enough experience on its usability yet.

Figure 7: A new slider for controlling fading.

Another planned improvement concerns the identification of the creator of an annotation. We plan to add functionality to the user panel allowing a direct association between annotations and their creators.

Many users did seem to need a tool for creating persistent annotations. If this holds true in general we will implement it in a future version. We plan to make the creation restricted so that only the initiator of the discussion may decide which annotations should be persistent.

It should also be possible to comment on the annotations that have completely faded to the background. We are planning to include a tool for refreshing an annotation. An old annotation would be moved forwards in discussion or a copy of the old annotation would be created. We do not know which way is better but plan to find it out.

In addition to the improvements in the system, we need to make a more comprehensive analysis on the usage of the system. Currently, we do not have enough data on the actual usage of the used visualization along with the history slider. We should also use the methods of *conversation analysis* in making observations on the structure of the discussions.

7 CONCLUSIONS

There are only a few examples on successful application of visualization techniques in groupware. Yet, from the simple examples (Ellis *et al* 1991) to the more complex constructions (Viegas and Donath 1999), the techniques have proven to be useful additions to groupware systems.

GraffiDis is a discussion system intended mainly for asynchronous communication. It uses a visualization technique combining fading and free positioning in a 2D space. Above, we have described the system and sample discussions to illustrate the possibilities of the system.

We identified two main types of discussions conducted with the system: Non-focused discussions without a clear target for the discussion and focused discussions with a specified target available in a picture.

Although the users were actually quite enthusiastic about using GraffiDis in conducting non-focused discussions, it

is evident, that is doesn't offer very much advantage over a typical text-based discussion system. But, our experience has been that GraffiDis is a natural and effective tool for conducting focused discussions. It offers an easy way for sharing comments and referring them directly to the target.

The experience gathered from the usage of the system has convinced us it is worthwhile to continue the development of the system. Our work continues with improvements on the system and with a more detailed analysis of the discussions conducted with the system.

8 ACKNOWLEDGEMENTS

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