ComDesk beyond remote assistance: a survey of desktop image sharing function

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ABSTRACT

This paper explores the possibilities that desktop image sharing might have according three communities with Human-Computer Interaction interest. The study indicates that desktop sharing has mainly been used for remote assistance and that the function is already well known among this community. Half of the communities clearly indicated that sharing the image of the desktop has a strong relation with collaborative work. However, little attention has been put on this area that might have a crucial impact on the interface that we develop today. Different alternatives beyond the remote assistance are given by the respondent of our survey. We also present comDesk, a tool that foresees the importance of supporting a multi screen user by letting manage and control different screens. comDesk presents an alternative to solve some of the problems that we found when sharing a desktop image. Some design possibilities are presented as well.

Keywords

Desktop image sharing, lightwieght communication, multi screen user, collaboration,F

1. Introduction

A common activity in most working environments is to put on view an object for someone else e.g. a document, a chart. This could be done in a lengthy formal meeting or just during a flash informal meeting. Sharing an object, specifically its view, in a collaborative activity is essential. WYSIWIS (what you see is what I see), [12] refers to view the same part of a virtual workspace to different users at different displays. This approach evolved to what is called relaxes WYSIWIS in which users can have different views of the virtual workspace [11]. Most groupware designers take this principle into account when conceiving their groupware applications.

As computers are being used by more and more people for a huge variety of services, the need to support them is central, not to mention the computer related technical problems they might face. A cheap and often effective way to do this is at a distance. This is called remote assistance. Remote assistance can be synchronous e.g. by phone or asynchronous e.g. by email. Synchronous remote assistance can offer remote control. Remote control denotes an application that allows operating a computer from another computer. An essential function that facilitates remote control is to allow the expert to view the desktop image of the controlled machine. Data transfer between these machines is also possible.

Remote assistance has gained a big importance as expected and some operating systems, e.g. Window XP, offer some features that allow remote assistance. Desktop image sharing is one of the most popular features of remote control. However, sharing the image of someone's desktop with others is a topic that we consider merits particular attention. This function in itself has become popular and some software offers this function, for example NetMeeting. We will call this function Desktop Sharing (DS). The easy access to DS might indicate that this function will be extensively used by different users in the near future (not necessarily for remote assistance). This could represent a significant change in the way users interact with their single-user applications and even in the way they structure and organize their desktop. Generally speaking, the relatively exclusive private characteristic of the desktop image is moving toward a public characteristic that users are not accustomed to. This may perhaps affect the design of any interface and therefore merits investigation. We argue that DS possibilities are not explored thoroughly and that they could be used extensively for other collaborative activities than remote assistance.

This paper explores DS. We present a survey that explored the use given to DS and envision of its potential use by people who has a Human Computer Interaction (HCI) background or interest. It also explores for and against issues that can be presented while using DS. We also present comDesk an application that allows, among other things, desktop sharing, but a potential solution for many of the problems found in the survey.

2. What do remote assistance users have to say about DS?

A starting point of this investigation was to observe what has been reported by some of the commercial software companies who offer remote assistance. A search on the Web of such tools was undertaken. We selected three of them. The selection was based

on the possibility they gave to test their product, and the access made available to their users case studies. It is important to note that in the case studies we revised the users were companies or organizations that offer remote assistance to their users, for example, a bank, university library, a software firm. We are aware that the results presented by the commercial software companies might have a promotional character. However, we consider that this information could give us some insight about the possibilities that DS could offers.

Commonly, these tools offer different functions like remote control, chatting, desktop sharing images, mouse and keyboard control. In total 15 case studies presented by these commercial firms were read. The aim was to determine the key factors relevant to using DS. The key factors that we found were:

- Showing is better than explaining; especially when what has to be explained is very simple

- A lot of people have a computer at home and broad bandwidth which makes suitable the use of their software[1]

- They could reach more people as there is no need to travel and they could also support customers that were far away

- End users cognitive overload was reduced: no need to know which file they have to send, nor need to read meaningless information from the screen to the support team

- Guess work was eliminated as they could see users actions and their results.

Some of the commercial systems we selected were very simple to install and use. For example, one of them uses the Web to present to the end user the screen shot of the machine that has the software installed. The end user does not need to install any software. He/she needs only the URL that the users who installed the software were given by the commercial remote assistance system, for example http://myName.DS.net.

3. HCI *connoisseur[2]* and DS: what has it been used for, what it might be used for, and reasons in favor and against

An email survey was sent to three mailing lists. The aim of the survey was to explore the possible use that users with a broad experience in software interaction would give to DS, how much these tools have been used by them and for what, and their opinion about DS. We decided to target people who had HCI background or interest. Three mailing lists were selected. Members of list A were part of a graduate school located in Sweden. Members of List B were part of an association located in Spain. Members of list C were part of a research lab located in Japan. These mailing lists were selected because at least one of us was member of one of the lists.

The survey consisted of open-ended (4) and simple selection (2) questions. The total of members in the three lists is 210. They

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[1] This aspect is political-economical predisposed

[2] The expertise degree of our respondents might vary from expert to novice in the filed of HCI.

were given a week time to respond the survey. In total 13% of the population (28) responded the survey.

Table 1.   Mailing lists to which the survey was distributed

List	Members in the list	Members who replied	% Total who replied
List A	55	12	43%
List B	138	8	29%
List C	17	8	29%
Total	210	28	% Members in the list 13%

The first question of the survey aimed to know whether the participants knew about what the possibility of sharing the desktop image with others. After that question a hypertext link was added. It linked to a picture that gave general idea about DS. Another question encouraged participants to propose a task that could be supported by DS. It is important to note that for this question it was explicitly asked to avoid examples in which a DS could be used as a remote assistance tool. The other questions explored how DS had been used by the respondents and the reasons why they would use or not such function. The open-ended questions were analyzed and categorized by one of us. Later, we refined these categorizations to avoid redundancy. The frequency of the categorization was charted.

3.1 Results of the survey

A great majority of the participants (86%) had previous knowledge about DS. However, 30% of them have never used them. Those participants, who had used DS, indicated the tasks or purpose when they had used it. Almost 60% of those who had used DS specified that the task they performed was remote assistance. No more than 20% used DS just for curiosity. Nevertheless, there were other activities or purpose that were reported. For example, distance learning, to present the slides for a seminar, a talk, or a lecture.
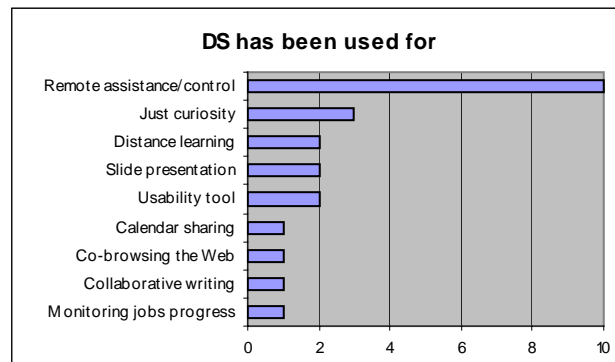

Figure 1.   Tasks that were performed by the participants using DS

Interesting that some (2 people) had used DS for usability test. Calendar sharing, co-browsing the Web, collaborative writing, and monitoring the progress of a long job were other activities that were performed by the participants using DS. It was not clear from the responses how often these activities were performed, however. Figure 1. shows the tasks that the participant performed using DS.

Participants were asked to suggest a task that DS could support excluding the remote assistance examples. Collaborative writing and momentary viewing of an object were the two most mentioned tasks. The last category, momentary viewing of an object, refers to showing something easily, quickly, and without saving the information in the local hard disk. Many of them considered that learning could also be supported by DS. The following three most mentioned tasks that participants considered that could be assisted by DS were 1) to make a demonstration of a particular software: it was not indicated, however, whether the purpose was promotional or instructional; 2) usability test; 3) collaborative drawing.
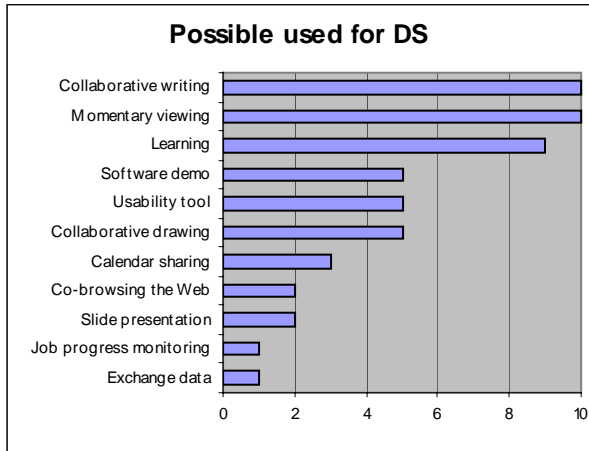
Possible used for DS

Task	Value

Figure 2. shows the tasks that the participant indicated that could be supported by DS.

Figure 2.   Proposed tasks that DS could support

Calendar sharing was another task that some (3) of the participants mentioned. Other tasks mentioned were monitoring the progress of a job that is running on a different machine, to show slides for a presentation with the aim to get feedback, and co-browsing the Web. Figure 2. shows the tasks that the participant indicated that could be supported by DS.
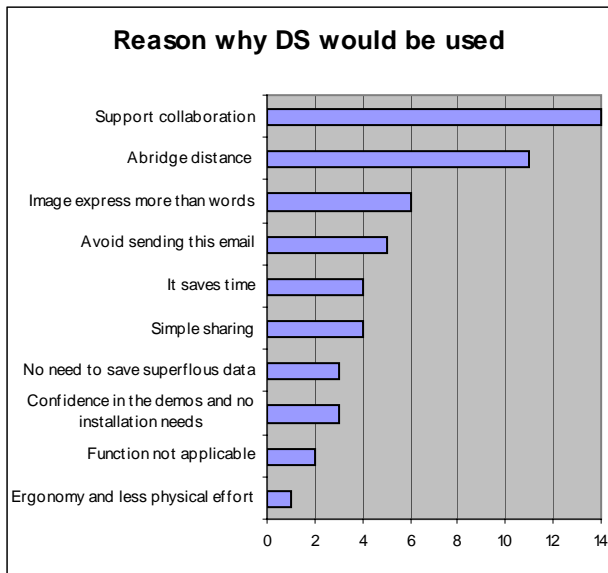
Reason why DS would be used

Figure 3.   Reasons given by the participants in favor of using DS

Participants were asked to clarify why they would use DS. Different reasons were given. Half of the respondents considered that this function would promote collaboration among team members or at work with other colleagues. The second most mentioned reason was that distance among collaborators is abridged. Almost 40% of the participants indicated this reason. A few, 21%, considered that it is important to show images as in many cases this media was richer than using text based communication. This of course depends on the task that the respondent had in mind when this option was given. Five participants, almost 18%, indicated that the use of DS might prevent sending an email with an attachment to show something that the receiver was going to see just for a short time. This reason was also supported by saying that the users who received the image of the desktop did not have to save that information in local hard disk.

One more reason given by four participants was that they thought that DS could save time. However, it was not indicated how it *saved time*. Four participants thought that it was an easy and simple way for sharing information. A further reason shared by three participants was that when demonstrating software it was good to be able to do that from their local machine. This was supported by saying that no installation was needed and that the demo was more likely to happen as expected. Only one of the participant thought that DS might be favorable for ergonomics aspects and less physical effort e.g. no need to walk to see someone's else desktop. However, two of the participants found that such applications were not applicable (both had previous knowledge about DS but never had used it). Figure 3. shows the reasons mentioned by the participant in favor to use DS.
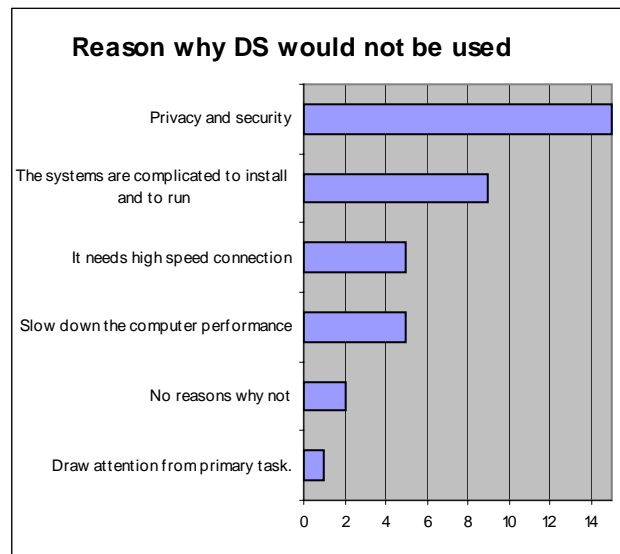
Reason why DS would not be used

Figure 4.   Reasons given by the participants not in favor of using DS

The last question referred to suggest the reasons why DS would not be used. More than the half (54%) of the participants indicated that privacy and security were the major concerns to use DS. The second most frequently mentioned reason was that respondents considered these systems complicated and difficult to install. Two more reasons, related to the hardware and the technology, were given. The first was that high-speed connection

was needed and the second that computer's performance slows down significantly while this software is running. One participant foresees it as distracting and confusing to have the desktop image of another machine on his own one. Nevertheless, there were two participants (both had used DS before) that found no reasons why this kind of software should not be used. Figure 4. shows the reasons that the participants mentioned not in favor to use DS.

4. Discussion

4.1 Support for collaboration

A great amount of people with interest in the area of HCI is aware of DS. DS have mainly been used for remote assistance but other task has been performed. DS is regarded by them as a potential feature that can support collaboration. Very likely it is because sharing has a strong link to collaboration among our respondents. However, little attention has been put to explore DS potentiality from a collaborative perspective or the impact that sharing the image of the desktop might have on users.

In collaborative work many activities can be performed opportunistically. Moreover, these activities could not fit pre-defined roles responsibilities or plans. This was observed [1] in studies of collaborative writing. [13] argued that lightweight communication (brief, informal, unplanned, and intermittent communication) is vital for communication in a workplace. Note that a few indicated that sharing an image was better than trying to explain with words that they want to communicate. DS can be seen as a mechanism for showing a particular image in a brief, informal, and unplanned form: lightweight communication. [3] presented the system Notepals that attempts to give group members direct access to their ideas and experiences by allowing them to view each other's personal notes. They found that group members could more easily benefit from their collective experience (p. 338). The possibility to present images is also a way to present their ideas and their experiences. [7] and [2] maintain that the functions for groupware are less frequently used than those functions that allow individual work. The main problem is to learn how to use these groupware functions and find a reason why "…abandon their favorite word processors to use a co-authorship application" [7] We consider that just sharing the image of the desktop can be considered as an individual activity while it could have a tremendous collaborative impact.

4.2 Privacy issues

Giving your email address or the URL of your homepage to a person you just met is probably something many have done e.g. for contact information. However, we argue that giving the means so that a person you just met can share the image of your desktop would be considered much more. This might not be perceived just as contact information but giving the means to be observed by others. This is in line with the result of the survey in which many of the respondents indicated that privacy and security were the main issues why they would not use DS. Users are not accustomed to the fact that others can access the image of their desktop. Therefore, it is natural that some people are not in favor of using DS, as they cannot see the benefits of using it. Moreover, confidential information might be shared without consent.

There are objects that are very personal. However, there might be a need to share them under certain circumstances. For example, you have probably passed on your calendar notebook to your colleague to provide a better overview of the potential time when

to meet. Nevertheless, you would not allow someone making a note on your calendar notebook. Someone would hardly dare to make a note as well. Showing your calendar might imply disclosing information that you might not want to disclose e.g. a date with your fiancé. Moreover, users connected to the Internet or Intranet might be running several software (e.g. ICQ, MSN messenger) on the background. These software could pops-up a notification message compromising the user integrity and privacy. As one of the participants said: *"The single time that I used it* (DS) *I did not notice that I had an email opened in one window which contained private information"*

This problem is more acute because the applications that allow DS, present the whole desktop image to the receiver and the sender (owner of the desktop image) has no possibility to control which area of his/her desktop image should be shared.

Very likely, the level of trust needed among collaborators who share desktop images will be higher than the one needed to inter exchange emails. Possibly, the demand for a previous meeting face to face among distributed collaborators is more crucial [10].

However, it is important to note that the result of our survey in relation to privacy issues might be different in other settings. For example, privacy policies in the industry are quite different from the academia.

4.3 Problems reported of using DS

Generally, the source desktop image is presented shrunk on the target desktop. Some visualization problems might be present, therefore. The weight of this problem is related to the screen size and settings for both the source and the target desktop. Our respondents indicated that visualization problems were presented when they used DS. One of the problems mentioned was to have an overview of the source desktop screen. Users could be forced to scroll up and down the presented view to get an overview of the shared desktop. This could be perceived as an overhead activity by the users. A possible solution in certain cases to this problem might be to change the screen settings e.g. size. One of the subjects who experience this problem wrote *"I do not want to resize my screen size just to look at another screen, especially when this is for a short time"*

Another subject pointed out that it would be difficult to conceptualize what parts of the desktop image were focused upon by the person who is viewing it. As the image that is sent presents of the whole desktop, the sender cannot be sure to which part the receiver will focus on. This problem is alleviated when the sender can control which area of the desktop is shared.

Slow updates can generate other problems for understanding the working context. Images can overlap each other presenting the information in a layout that is difficult to understand.

4.4 Probable use of DS

It was mentioned that DS was of great help for software demos. The main reason given was that it was not needed to install the software in other machine. Software installation could present some problems that might decrease the customer's acceptance of the product. Another use, close related to remote assistance and demos, is to demonstrate how a to solve a practical problem. For example, a user could ask a colleague to show how to perform a task that he/she cannot work out. This could be considered a sort of lightweight communication.

The image that is presented from the source location could have some characteristics that might not be presented if the file is shown from any other machine. For example, the layout of a Web page using Cascade Style Sheet (CSS) would be presented totally differently depending on whether the browser enables this option or not. Another example is to present a particular font or character set e.g. Japanese, that is installed in one machine and not in the other one.

The exchange of information is increasing everyday and users probably have recognized that there is a sort of information that could be called as *disposable information*. With disposable information, we refer to the information that might be viewed once for a short period, for example, the calendar of a colleague to make an annotation in your own one. Disposable information might probably be used often in real time or lightweight communication.

A common channel of data transferring today is sending an email with an attachment. Some of the respondents pointed that DS could be an alternative to avoid sending an email with an attachment. Especially, when the attachment contained disposable information that consume precious and expensive server-side storage. Not sending an email not only means that his/her quota is not affected but also that the receiver is not distracted by an alert signal. One respondent mentioned that she has been asked not to send a document by email because the receiver wanted to preserve some space free of the email quota. It is important to point out that the document in question could not be considered disposable information according to the respondent. DS in this case is not an alternative either. However, it is important to note that the receiver of the email was concerned for the occupied space that the document was going to take.

Users are presenting new requirements: sharing information in digital format but not sending an email. This requirement can be a consequence of the problem of overwhelming number of emails that most of the email users are suffering today. Many users are receiving unsolicited emails. For this reason, it is likely that some email users are not willing to send an email with disposable information. This topic needs more investigation and is out of the scope of this paper.

Some of the respondents indicated that DS could save time. A possible interpretation to this is that preparing an email to send a file to be viewed for a short time is not always easy e.g. where is the file location. This could also be related to the fact that moving from one place to the other e.g. from your office to your colleague's one, is not longer needed when they just want to show something in their desktop. Also, trying to explain what is presented in your desktop might be difficult and time consuming. Users might have referred that showing the image of the desktop would save time, as there is no need of complicated explanations.

5. comDesk: a Communicable Desktop System

5.1 Overview

It is common that users deal with different electronic devices that present information on diverse screens e.g. a personal computer, a palm, mobile telephones, electronic boards, etc. Each of these screens is a channel of information that has to be managed by the users. Moreover, these channels might be interconnected. More and more frequently users swap from one screen, e.g. the personal

computer, to another, e.g. a palm. The single screen user is succeeding its place to the multi screen user. The need to support multi screen users is therefore relevant. However, little support is given for the administration and management of several screens simultaneously. A possible way to handle several screens is by sharing their images in one screen that is directly operated by the user. This means presenting the desktop image of the screen devices to the user. This can be seen as a particular case of DS. Furthermore, the possibility to share desktop images among users might be used for collaboration according the results presented in this paper.

comDesk (short for communicable desktop system) [9] is an application that allows sharing, controlling, and managing multiple screens. It was designed with a collaborative perspective by letting users to share desktop images and perform file transfer operations. Figure 5. shows a complex situation that can be supported by comDesk. There can be two levels of communication. The first level covers the need that a user has to supervise a set of monitors. The second level covers the need that users have to communicate among each other. This communication, very likely, might be related to the observation they have made on the screen they have to supervise. It might be of help in the communication process that users could view a particular screen in question in the discussion, regardless of whom is responsible for that screen.
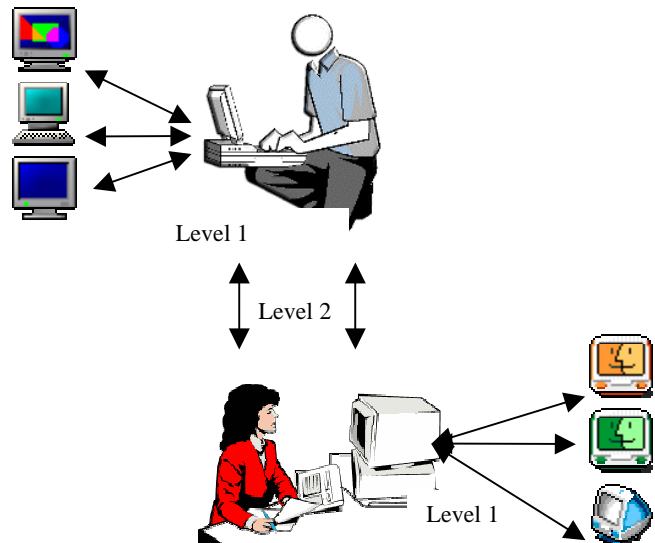

Figure 5. **A complex monitoring working environment using computer and the need of communication among users is present**

To make the system simple, we have adopted a P2P (peer-to-peer) technique rather than server/client model. P2P suits for a "symmetry of the hosts," which contributes the ease of the desktop sharing system. comDesk has an automatic configuration feature to find other hosts running the comDesk system in the subnet. This feature is useful because users are free from settings of any IP-addresses.

5.2 Interface and Functions of comDesk

To start a comDesk session, the user has to login to the screen device (e.g. PC, Palm). Each screen joined to the group is called a comDesk instance. Observe that a comDesk instance can belong

to the same user or to a different one. Every comDesk instance is represented by an icon named *Host Icon*. The host icon can be represented by two views based in a fold-unfold principle.

advantages. The data size of the cropped image becomes smaller therefore the update can be faster. The receiver can easily handle the cropped view with few scrolling. Also, it is easier to
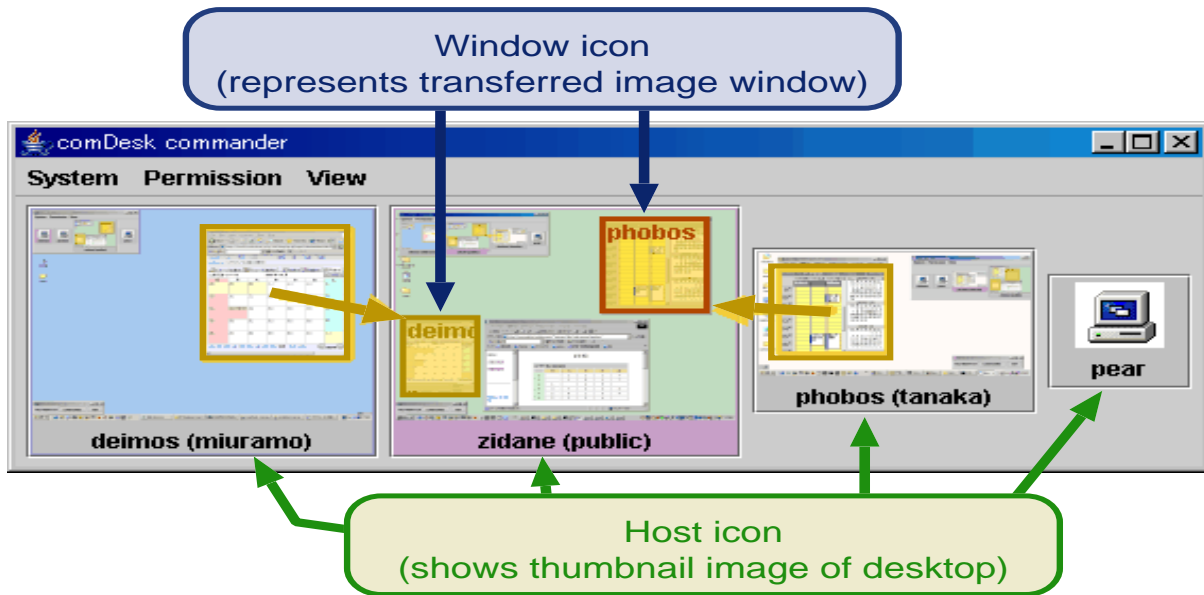
Figure 6.   comDesk commander window.

Initially, it is presented as a small screen icon (fold) that when it is activated (unfold) it depicts the whole desktop image (thumbnail image) of the screen it represents. The set of host icons that can exchange desktop images, control and transfer files among themselves is called a comDesk cluster.

The comDesk cluster is presented in the comDesk commander. Figure 6. shows a comDesk commander window presenting a comDesk cluster formed by four host icons (*deimos, zidane, phobos* and *pear*).

The representation of an unfolded host icon has some visualization problems because of its size. It is hard to observe the details. To get a better overview or a detailed representation of the host icon, the user can *transfer* its image onto another host icon. To do this, a drag (of the source host icon) and drop (to the target host icon) operation is required. As a result, the image of the desktop appears in the dropped host. This is what we call a comDesk image window. If the host icon is unfolded, the dropped point determines the position of the comDesk image window on the desktop screen represented by the target host icon. The shrink rate, which can be manipulated by the user, of desktop image presented in the screen is ½ at first.

comDesk provides "partial transferring" which allows owners to specify the portion of the desktop image to be transferred. This feature is effective when the whole desktop image includes user's private information. This "partial transferring" function can relieve some problems of using conventional desktop sharing applications as collaboration. First this function allows the user to limit the transferring area as small as he/she desires. It is useful for keeping private information from colleagues. Also the function can be used to let the receiver focus on the specific area. Moreover the "cropped image" brings some supplemental

determine which information the user is focusing on.

When a transfer is done, the target host shows the "Window icon". The window icon represents the source desktop image. The position of the source desktop image in the target desktop can be manipulated by its window icon in the target host icon. The direction of the transferring operation is represented by an arrow in the comDesk commander (from source to target). When a comDesk cluster has two or more users, a transferring operation, from a host icon created by Akinori for example, can be accepted/rejected by the owner of the target host icon, say Alberto. Furthermore, instead of the whole desktop image, Akinori can determine which fragment of his desktop image is to be transferred. Akinori can crop the fragment of the desktop image that he wants to transfer. That is what we call partial desktop image and it will be extended later in this section. In Figure 6. , we can see two transferring sessions: (1) partial desktop image of deimos is transferred to zidane (2) partial desktop image of phobos is transferred to zidane. comDesk commander shows (a) the host name (b) the host icon (c) the owner's name (d) and the session status, including where comDesk image window is shown. This transferring information might be useful for group communication and awareness. Awareness helps groups to reach semantic consistency of their work [5]. All participants (the users of comDesk) can refer to these kinds of view from any joining hosts they use.

After a transferring session starts, both the user of the source host (owner) and the user of the target host (receiver) have permission to control the window and the session by manipulating the Window icon. Dragging a Window icon affects the corresponding comDesk window, that is, the location and size of the comDesk window can be changed by remote hosts. The lower-right area of window icon is allocated for resizing, and the rest of the area for

moving. In addition to this, the owner can drop the Window icon to another Host icon, which causes "re-transferring of a window." The common drag and drop interaction for both Host icon and Window icon is intelligible for a consistent paradigm of transferring operations to the users.

The comDesk image window is updated when it is requested by the owner or the receiver. The receiver can change the target of the comDesk image window at anytime without losing the current image. For the owner of the source host, the "re-transferring of window" is also used to regain the transferring image. Other functions, like changing resolution and disconnection, are possible as well.

Remote operation comDesk image window shown in Figure 7. enables the remote user to control the source host by mouse operation while the "control" checkbox is on. The checkbox can be controlled by not only the owner but also the remote receiver of the image. But the owner of the image has a special authority that he/she can completely disable the "control" checkbox by context menu of Window icon. Changing the preference by owner immediately affects the corresponding comDesk image window. Also the owner of the source host can quit the session. The default state of the preferences are decided depends on the relationships of owner/receiver/operator.
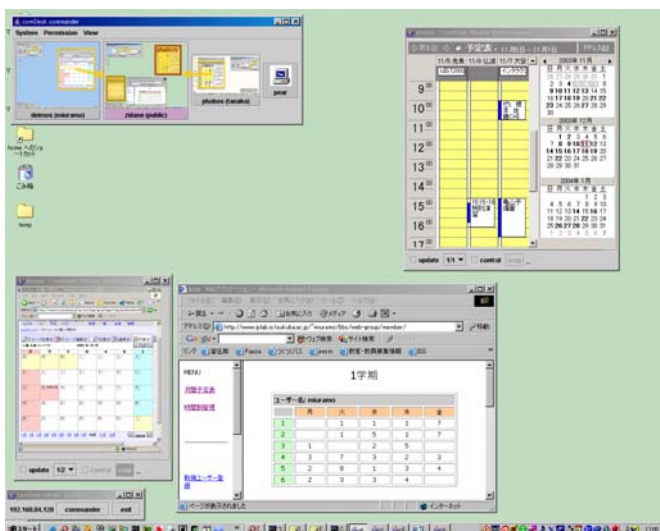

Figure 7. Whole desktop image of host **zidane**

6. Conclusion and future work

Our survey shows that many of the respondents think that DS could support collaborative work. However the use of DS has not been explored within the research community. It is important to explore the use of these tools in context when used for collaboration and study the impact that they might have for the users. For example, it would be interesting to explore the effect that distributed pair programming [4] might have. What would be more effective in distributed eXtream programming [8], two or three programmers when the physical limitation imposed by one screen is overcome?

We argue that the use of DS can promote lightweight communication and it is a very easy way to share information among co-workers. Co-located or distributed group can have benefit of this pure visual form of communication that can be complemented with other channels e.g. text or the phone.

Most of the problems reported by the users are originated because DS is presented as a whole. The possibility, that ComDesk gives to the user, to transfer a selected portion of the desktop might be a possible solution for these problems. However, different alternatives should be taken for the future design of DS. We propose that the user should have total control on what can be transferred to others. For example this could be done in three different ways. The first is just to let transfer the active window that is presented on his desktop. The second one could be application oriented. For example, the user might select which are the applications that he/she would like to share e.g. his/her word processor and calendar program. The third option is to indicate which portion of the desktop are can be viewed e.g. the left upper area of the screen. All these possibilities can have different impact depending on the users and the environment in which they are used.

Even though the number of respondent for this survey was not great (28) and the selection of the mailing list was somehow subjective, we consider that it gave us valuable information. We are planning to make a similar study in which more information can be collected form the respondents and also to study the possibility that DS could give to collaborative writing.

The possibility to manage multiple screens is already today important and it will be essential in the near future. comDesk is pioneer tools of this kind.

7. Acknowledgments

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