Dimensions of Virtual Co-presence

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ABSTRACT

Interactive virtual co-presence systems represent a major step beyond the single user - single system paradigm which has dominated the field of interactive human-computer systems for decades. Developers of virtual co-presence systems are faced with large design spaces for the analysis of which conceptual tools are much needed. The paper presents a set of empirically based dimensions for characterising the virtual co-presence part of such systems, which can be used as a matrix in design space analysis.

KEYWORDS:

Virtual co-presence systems, participatory design, human-human-computer interaction, design space analysis, conceptual tools.

1. INTRODUCTION

Interactive virtual co-presence systems (or virtual meeting places) represent a major step beyond the single user - single system paradigm which has dominated the field of interactive human-computer systems for decades. It seems reasonable to expect that, in five-to-ten years time, most human-computer systems and interfaces will include aspects of virtual co-presence. This paper proposes a set of empirically based dimensions for characterising virtual co-presence systems, which can be used as a matrix when specifying virtual co-presence systems and analysing the design space around a particular virtual co-presence system type or token. The dimensions were identified on the basis of the responses received to the first user questionnaire that was issued as part of the participatory design process for developing the virtual co-presence system Magic Lounge.

The Esprit Long-Term Research project Magic Lounge (http://www.dfki.de/imedia/mlounge/) which is one of thirteen collaborating projects in Intelligent Information Interfaces for the broad population (http://www.i3net.org), is scheduled to develop three increasingly advanced prototypes of a generic virtual co-presence system whose hallmark is *interoperability*. Users will be able to participate in virtual meetings in Magic Lounge using a range of different access devices, from workstations equipped with one or more screens, cameras, microphones and loudspeakers, to PDAs, ISDN video, mobile phones and telephones.

The participatory design process for Magic Lounge involves an end-user population of eight inhabitants of some of the smaller Danish Isles. They have very different professional backgrounds but share an enthusiasm for advanced computing technologies which allows them to participate in the project without prior training and extensive supply of novel equipment. The users received a first questionnaire including 24 questions and a brief description of the purpose of Magic Lounge in September 1997. In response, the users provided a wealth of information which will be presented elsewhere. This paper focuses on systematising and generalising a small part of the information, i.e. that part which helps reveal the complex dimensionality of virtual meetings.

2. THE USERS' MAGIC LOUNGE
AND THE DIMENSIONALITY OF VIRTUAL MEETINGS

User answers concerning virtual co-presence were grouped under the three headings which are shown in Figure 1 along with examples of user answers. It appears from the answers that virtual meetings or

meeting activities can be characterised in terms of a series of distinctions. These distinctions define dimensions of the design space around virtual meeting systems in general. The distinctions made in, or suggested by, the data are listed in the first column of Table 1.

Based on a single data set, Column 1 of Table 1 cannot be claimed to be exhaustive. It illustrates, however, the complexity of the design space around virtual co-presence systems by showing that these systems may have many different instantiations. Across the nine dimensions, virtual co-pres-

(a) Collaborative task contents (30 different answers)

1. Banking: face-to-face, more-than-two-at-a-time meetings with colleagues in other small independent banks to discuss common problems and solutions [possibly advanced topical, professional].
2. Cattle raising discussions [possibly advanced topical, professional].
3. Distance teaching and teaching preparation [possibly advanced topical, possibly professional, broadcast].
4. Home shopping in stores located outside of the island through human-human communication rather than through form filling [possibly single].
5. Information collection tasks.
6. Labour union meetings [possibly chaired].
7. Planning: joint planning [possibly advanced topical].
8. Political meetings [possibly large].

(b) Collaborative activities (with no mentioning of specific task contents) (14 different answers)

1. Application sharing of spoken, textual and graphical information [advanced topical, possibly professional].
2. Conferences and meetings with people from other islands and elsewhere [possibly chaired, possibly large].
3. Distribute minutes and call for meetings on my own island [single].
4. Meet people from other European countries who share my interests [possibly advanced topical, possibly multilingual].
5. Professional meetings [advanced topical, professional].

(c) Communitarian aims served by Magic Lounge (16 different answers)

1. Counter a diminishing population.
2. Counter the need for receiving education away from the island [possibly advanced topical, possibly professional, broadcast].
3. Create jobs for geographically separated people [advanced topical, possibly room sharing, professional, possibly single].
4. Reducing the distance to the rest of Denmark and the world at large.
5. Simultaneity: more communication can be done synchronously.
6. Strengthening the common European identity [possibly multilingual].

Figure 1. Examples of user answers. Discrepancies with the original Magic Lounge specification are in square brackets.

ence systems may be more or less sophisticated in terms of the functionality they afford their users: for access, navigation, user representation, communication, privacy protection, automatic system support and so on, as well as in terms of the topological complexity of the virtual meeting complex itself. The nine dimensions appear reasonably orthogonal so that, in general, only a limited amount of implications follow from the fact that a virtual meeting place has a certain property along a certain dimension, such as being *regular,* with respect to its properties along other dimensions.

3. CONCEPTUALISING VIRTUAL MEETING PLACES

An obvious use of the dimensionality of virtual meeting places is in the *characterisation,* or *specification,* of virtual co-presence systems. The dimensions enable a relatively fine-grained description of particular virtual meeting places. Consider Magic Lounge as an example. Behind the current version of the system lies a vision of its function and purpose. Magic Lounge is currently being designed for the dimensions marked in Column 3 of Table 1.

Representation of Magic Lounge within the surrounding design space clearly indicates a number of interesting potential extensions of the functionality of the system. Moreover, the representation raises the question whether the current conception of Magic Lounge is, in some sense, "well-circumscribed" or whether reductions or extensions to its scope, as defined by the dimensions in Table 1, would lead to a more "well-circumscribed" system. The dimensions thus provide structure to the design space,

which must be taken into account in all design decisions. Generalising, the dimensions provide structure to the design space around virtual co-presence systems, which must be taken into account in all design decisions concerning particular systems to be built. If this is not being done, the risk is to develop unfocused or non-intuitive design solutions.

A second use of the dimensions of virtual meeting places, therefore, is for *guiding design and development*. The guidance consists in facing the system designers with decisions to be made concerning the tasks which the system should support. Defining a virtual meeting place to-be-designed in terms of the dimensions in Table 1 may support focused thinking about the properties

Dimension of Virtual Meeting	Users' ML	ML	Distance teaching	All-purpose
chat	x	x		x
topical	x advanced	x limited	x advanced	x advanced
one-of-a-kind	x	x		x
regular	x	x	x	x
room sharing	x			x
equal-footing	x	x		x
chaired	x			x
broadcast	x		x	x
ordinary-people	x	x		x
professional	x		x	x
single	x			x
bilateral (2 users)	x	x		x
small (3-10 users)	x	x	x	x
large (+10 users)	x		x	x
equal access (same devices)	x	x	x	x
interoperable (different devices)	x	x		x
public	x	x		x
private, announced to others	x	x	x	x
secret (unannounced to others)	x	?		x
synchronous	x	x	x	x
asynchronous	x			x
single-language	x	x	x	x
multilingual	x			x

Table 1. Comparison between the Magic Lounge (ML) that was collectively envisioned by the users, Magic Lounge, a standard virtual meeting place for distance teaching, and an all-purpose virtual co-presence system.

the artefact should have as well as the properties it need not have. For instance, there does not seem to be any reason to consider the issues involved in setting up *room sharing* facilities in Magic Lounge.

Another, related way of using the Magic Lounge partial specification in Table 1 is to let it drive the systematic *selection of scenarios of use* during design and development. For instance, in developing Magic Lounge, we should consider both scenarios involving two users and scenarios involving ten users, as the functionality needed may be somewhat different in the two cases. Jointly, the two scenarios can help explore the functionality needed for allowing smooth communication between different numbers of users within the intended number-of-users scope of the system. Similarly, the matrix may be used in analysing the scenarios chosen by the participants in participatory design processes, thereby helping to judge their relevance for the design process.

As illustrated for Magic Lounge, the relative independence of the dimensions of virtual meeting places suggests a way of "profiling" or analysing particular virtual co-presence systems. Distance teaching systems, for instance, would be generally characterised through the dimensions marked in Column 4 of Table 1. Standard distance teaching meetings would thus lie outside the present scope of Magic Lounge, as being: more *topical* than Magic Lounge, *broadcast, professional* and (sometimes) *large*. A third use of the proposed dimensions, therefore, is for *comparing virtual co-presence systems*. The matrix contains a number of variables which may be instantiated in various combinations to define specific virtual co-presence systems.

The all-purpose virtual meeting place (Table 1, Column 5) obviously does not exist at present. It is not even clear that its development might be desirable, given the fact that generalising the purpose or scope of particular computer systems often tends to enforce undesirable compromise design solutions.

In fact, the "Users' Magic Lounge" is identical to the all-purpose system in Table 1. It is obvious from comparison between the initial Magic Lounge specification and the users' answers that many of the tasks for which the users would like to use Magic Lounge are not supported by the currently envisioned system version. For example, many of those tasks are advanced *topical* or likely to be so (Figure 1) beyond the limited topicality envisioned for Magic Lounge, and therefore need a diversity of application sharing functionality which Magic Lounge is not currently being designed to provide. The same applies to the *professionality* of several of the tasks. Furthermore, some of the tasks proposed by the users may: involve a *large* number of participants, require *room sharing,* be *chaired,* be *broadcast,* be *single*, or be *asynchronous*.

Input on the tasks and activities which users want to perform, and on the needs they would like to satisfy, often *challenges* the developers' initial conception of the artefact. The variables in Table 1 help articulate these challenges. In fact, the Magic Lounge developers are facing a number of difficult design decisions when considering whether and how to revise the system specification to optimise its scope in terms of the tasks and activities that it should enable and the user needs that it should meet.

4. CONCLUSION

Based on the data from the First Magic Lounge Participatory Design Questionnaire, a representation of the dimensionality of virtual meeting places was derived. Use of the dimensions for the following purposes was illustrated:

1. characterisation and specification of the virtual co-presence aspects or functionalities of virtual co-presence systems;
2. guiding and challenging the design and development of virtual co-presence systems with respect to the purposes they may serve and the tasks they could enable;
3. driving the systematic selection of scenarios of use during design and development;
4. characterising the scenarios chosen by the participants in participatory design processes, to help judge their relevance for systems design;
5. comparing the functionality of virtual co-presence systems.

ABSTRAIT

Systèmes de co-présence virtuelle interactives signifient une démarche majeure au-delá du paradigme 'un utilisateur - un système' qui á eté dominant dans le domaine homme-ordinateur pendant des années. Développeurs de systèmes de co-présence virtuelle se trouvent devant des éspaces de dessin assez grandes et peuvent constater que, actuellement, il-y-à une absence des outils conceptuels pour analyser de tels éspaces. Cette article-ci présente, sur une base empirique, un nombre de dimensions pour la charactérisation de la partie co-présence virtuelle de tels systèmes, qui peuvent fonctionner comme matrice analytique pendant l'analyse de l'espace de dessin.