

# Bridging the Gap of Missing Human Mediators in Interactive Systems for Information Workers

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## ABSTRACT

Creative information work is nowadays - in spite of available tools - more challenging than ever before. This results on the one hand from the increasing complexity of digital information spaces and on the other hand from the problem that users are, in contrary to the analogue world, in most cases left alone by digital systems. The PhD project therefore tries to narrow the gap of the missing human mediators in digital systems for information workers. The proposal firstly introduces into the problem followed by the fundamental theoretical concepts of the work. Thereafter three research goals are defined covering (1) the usage of diverse context-information for the development of concepts, (2) the evaluation of the user-acceptance and (3) the examination and enhancement of development methods for context-aware systems. Subsequently, the chosen approach is illustrated concluding with the current stage of the work and a critical reflection.

## Categories and Subject Descriptors

H 5.2 [Information Interfaces and presentation]: User Interfaces - Graphical user interfaces, Interaction styles, User-centered design

## General Terms

Design, Human Factors.

## Keywords

Human-Computer Interaction, Information Science, Visual Information-Seeking, Interaction Design, Digital Libraries, Context-Awareness.

## 1. INTRODUCTION

The daily access to growing data spaces is a task of every individual, which has to deal with digital media and information (e.g. WWW, email, MP3-archives, digital libraries or social networks). Although information is available and fast accessible at any time, information work is still or even a more complicated task than ever before. One reason is the complexity of information spaces, which are continuously growing in quantity, heterogeneity and

dimensionality. Another reason is the lack of physical available human mediators in a digital world where users are left alone in most tasks, like during search, organization and processing of information. Kuhlthau defines this mediator as a person who intervenes in the search process of another person [8]. This intervention covers the assistance to access, locate or identify information items as well as the advising and constructive debating over certain topics. People have distinct characteristics, which are known as "individual differences" [2]. These factors for example differ in terms of experience, education level, personal interest, cultural factors, ethnical background and affective stages. In contrast to common digital systems, a human mediator such as a librarian recognizes these factors throughout the contemporary context and is therefore able to react appropriately to these individual differences, e.g. present selected information items in a way that can be understood or help in locating information items that are useful in a certain situation. Abowd et al. [1] describe this situation as: "When humans talk with humans, they are able to use implicit situational information, or context, to increase the conversational bandwidth." Furthermore, in a non-digital world people often use their social context in their working process, not only directly with mediators like described above, but also through an indirect mediation. For example, when someone is looking for a book in a library and one of the books in the shelf is much more worn than the others, this could be an indicator for its relevance left behind from other people. This type of interaction is called "social navigation" [4]. Novel interactive systems for information workers can try to support users by closing the gap resulting from the missing human mediators and therefore enhance information work. This is particularly important for more complex higher-level activities like "writing a scientific paper" or "investigating for a news article".

## 2. THEORETICAL BACKGROUND

Shneiderman introduced a "framework of mega-creativity" [11], an abstract model that describes the tasks of a higher-level activity of information work. In this model, every creative work starts with collecting existing information items of a problem domain. These early items are the fundamental to solve a problem by stimulating ideas concerning a systematic approach to generate new information items. Kuhlthau regards information work in her "Information Search Process" [8] as a constructive process, where individuals build or "construct" their own image of the domain. This model is of specific interest in the context of the PhD project, since it focuses on library usage and is verified by a number of empirical studies. The focus of this model lies on supporting the task of information search that is increasingly getting important

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Conference'04, Month 1-2, 2004, City, State, Country.  
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for information work considering the background of growing information spaces. Furthermore, she declares a highly iterative process covering six steps (initiation, selection, exploration, formulation, collection, presentation). During these steps, the user passes through different affective, cognitive and physical stages. The following scenario is a typical strategy, described in [8]: A student gets an assignment to write a report. In the beginning (initiation), she has a rather vague idea of what to do and search for and is therefore a bit uncertain in her actions. The student tries to search for everything that might be relevant to the topic. During the exploration of the first results, she starts to feel more optimistic and develops an idea (selection). By reading further texts, she comes across some information that does not fit with her idea (exploration). Again, she feels a little bit uncertain, confused, and frustrated. After a discussion with her tutor (the mediator), she tries to define a new focus point (formulation) to get more clarity. This step strengthens her confidence again. Her interest increases and she shifts strategy to seek more pertinent information (collection). When enough information is gathered or the time for the assignment runs out, she stops searching and tries to create the report, based on the collected information objects (presentation). Such a process of creative work is a highly individual task. Depending on prior knowledge and skills, every person might apply a somewhat different strategy. Kuhlthau stated that the uncertainty plays a driving role during the constructivistic process, especially in the early stages of the work. In the classic library scenario, Kuhlthau also ascribes an important role to the mediator, in this case a domain expert for both the search and the research topic such as a librarian. Furthermore, an external intervention through a mediator should be conducted at a certain stage, called zone of intervention. This zone is defined as that situation, when persons cannot proceed in their work on their own.

### 3. RESEARCH GOALS

While some of today's systems offer some kind of assistance to access, to locate or to identify information items, these are in most cases "one-size-fits-all" solutions and if they provide personalization, they are far from being systems that might respond to the user's individual differences, needs and situations. However, to many of the mentioned aspects could also be paid attention within the design of digital systems by the usage of context-information. During the PhD project, a novel workspace for information workers based on [10] and [5] in the context of digital libraries will be designed and evaluated, which pays attention to the described issues. As primary use-case serves the Mediothek of the library of the University of Konstanz that offers an information space with more than 70,000 multimedia objects such as movies or documentaries. Therefore three research goals are defined, which are tightly coupled and highly iterative. Eventually it should be emphasized that the intention behind these research goals is to find new ways in enhancing the interaction and user experience of workspaces for information workers.

(1) The first research goal is the design and implementation of concepts to close the gap of missing human mediators in today's digital systems for information work. Therefore, the system should on the one hand adapt to the individual differences and needs of the users in certain situations. On the other hand, the system should pay attention to the fact, that the user is not the only one that uses the system.

(2) Besides developing concepts, the acceptance of these will be evaluated with users as a second research goal. In particular, it is to identify in which situations, by which presentation forms and to which extent these concepts will be accepted by certain users or user groups.

(3) Finally, methods on how to develop context-aware systems will be evaluated and if necessary adapted for the setting of the PhD project as a third research goal. This covers modeling, capturing and processing of context-information.

### 4. CHOSEN APPROACH

To accomplish the first research goal context-information is used to adapt the system to the individual differences and needs of a user. This context-information covers personal information about a single user, social information about multiple users as well as system physical characteristics. The personal information will be a combination of automatically derived and optionally profiled information as well as information from current and past sessions. For example, the number of logins, duration of a session, frequency of usage of the system and frequency of usage of single visualizations or functions, the examined meta-data or inspection of information items like languages or genres are relatively easy to detect automatically. In addition, the user is able to extend the personal information manually either through a direct submission of personal information (e.g. preferred language, age etc.) or through digital questionnaires to get information that is difficult for the user to determine (e.g. preferred visualization). To pay attention to the social context and to benefit from the situation that there are more than only one user, it is useful to capture additional information for certain interest groups, for example for all users with the interest "Usability". This context-information is then joined with an intersection of the personal information from several users with same interests. All this context-information must be combined and projected to a context-model in order to define dependencies. Therefore, several context-modeling approaches, both textual or visual and informal or formal ones have been evaluated as part of the third research goal. As a result, a universal context modeling approach is not available and not desirable. It is therefore crucial to balance the specific aspects of the use-case. For that reason [12] defined some criteria, like distributed composition, partial validation, richness and quality of information, incompleteness and ambiguity, level of formality and applicability to existing environments to compare the different modeling approaches. By the use of these criteria and by creating priorities for the project setting a combination of modeling approaches could be found to describe specifically the context-information. For the use-case of the PhD project, the model will be an object-oriented one, similar to [6], to assure readability for machines and humans. Based on the context-model, interpretations will be accomplished in a first step with some predefined rules, based on user observations and expert assumptions. For example, the number of logins and duration of sessions give an indicator about the experience level of a user with the system or through the meta-data of viewed information items, it is possible to make a statement about a user's interest [3]. Furthermore, it is possible to identify the preferred tools, functions and visualizations. The social context-information may well be concatenated with specific emphasis. To give the user a feeling of control and privacy of their personal data, as it is required in [9], the context-model is user-accessible at any time. Therefore, a simplified visualization of this model will be integrated into the user interface

enabling users to open and edit the context-model and further determine which information they want to reveal to the system. With the integration of the context-model, the visualization and presentation of the system (system rendering) as well as the system behavior and content (system task model) will be adapted to the user's needs. The system rendering includes for example the visual design, the layout or the choice of visualization techniques. Adapting the system model could mean to change the content presented to the user or the amount of functionality offered by the system. Giving individual recommendations on visualization components, information items or functions based on how meaningful they are in certain situations as well as suggestions on how to approach an - as yet unexplored - information space (e.g. which documents to read first) is also meaningful. The system could further familiarize a more experienced user with advanced functions and visualizations that the user had never or rarely used before. It is intended to design and implement several alternative designs with attention on user acceptance of the concepts. Consequently, Normans design guides for smart machines [9] are respected. These propose systems to provide rich, complex, and natural signals, to be predictable, to provide good conceptual models, to make the output understandable, to provide continual awareness without annoyance and to exploit natural mappings. To get an indicator on how the user will accept the concepts, the different alternative designs will be evaluated against each other on behalf of the second research goal. Therefore, longitudinal user studies will be employed, because especially context-aware systems like described above will require multiple sessions to gather enough information about the user to generate a meaningful profile. During the development of the concepts, design methods for context-aware systems will be evaluated and if necessary advanced. One example therefore is the modeling of context described above. Furthermore, the integration of design methods of context-aware systems into a user-centered development process is an interesting issue that will be examined during the PhD project.

## 5. CONCLUSION

Until now, a technical framework based on the ZOIL paradigm [7] for the implementation of the design alternatives has been developed. Furthermore, an analysis of development methods for context-aware systems has been accomplished. Thereafter the modeling of the context and the rules for the interpretation has been worked out. At the moment, a first concept is getting implemented. I am aware that research prototypes of context-aware systems developed in the last decade have shown the value, as well as the challenges. These are manifold, such as recognizing the user's context or presenting the adaptation in an unobtrusive manner. Recognizing the user's context correctly in every situation is still more of a researchers' dream than a working technology. Although when regarding these challenges during design this approach could in my opinion enhance users work. Further, the mediation problem especially the more consulting-like tasks cannot be abolished only with better tools. A digital system will never be able to substitute a constructive discussion with a human. However, even in this point a digital system is able to support the user as a platform, which opens ways to other people. While the Internet itself provides possibilities to contact experts, a consistent integration of such a mediator approach is not yet available in a digital information workspace.

## 6. ACKNOWLEDGMENTS

This work was supported by DFG-GK 1042.

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