A classification for Supportive User Interfaces derived from Collaborative User Interfaces

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ABSTRACT
In this paper, we describe that the concept of supportive user interface is overlapping with aspects, which can be found in collaborative user interfaces and how this can help to classify and design supportive user interfaces accordingly.

Keywords
support, collaboration, classification

INTRODUCTION
The growing complexity of today's and future ubiquitous systems which is driven by innovative enabling technologies, new interaction techniques and concepts as well as context-of-use dynamics is raising new challenges regarding end user support. The User Interface (UI) has to be well designed by hiding complexity from the user but still providing easy access to all functions. It has to provide customization regards to user's personal needs but also has to adapt automatically to the context of use for reducing user disturbance while performing her tasks. These requirements are partly conflicting so that the resulting system behavior can lead to user confusion. To solve this problem, the system has to enable the user to understand what is happening and how the application behavior can be controlled as desired.

A promising approach towards extended user support is seen in equipping the UI with corresponding supporting functionality, which is developed and/or provided simultaneously with the primarily functions. These Supportive User Interfaces (SUI) can come in manifold ways which makes comparisons and discussions difficult because there is missing a classification as well as a clear definition of SUI by now. In this paper we propose a classification which is derived from Collaborative User Interfaces (COUI) since as we will show many parallels between SUI and COUI can be drawn.

In the following section the concepts of SUI and COUI are presented along with examples of their manifestations. This enables to elaborate several parallels of the both UI types in the section thereafter. As a result a classification for SUI is proposed and implications on design aspects for SUI are described afterwards. The paper will finish with a conclusion and outlook.

RELATED WORK
In this section an overview of the UI types SUI and COUI and their manifold manifestations is given. So that the parallels between SUI and COUI can be elaborated on the common understanding in the next section.

Supportive User Interfaces
The concept of SUI is to provide the user with support within complex systems such as ubiquitous systems by means of making the user able to understand what is happening in the system and how the system can be controlled as desired with the numerous interaction possibilities provided. The SUI can come in manifold ways like self-explanatory user interfaces [5], process driven user-guidance environments [10], extended device control support [9], guidance for different modalities [7], support by utilizing contextual awareness [1], and Meta-UI, which can control and evaluate the states of the underlying system [2] and therefore can enable supportive functionality, and assistance with visualization of system behavior [13] amongst others.

Collaborative User Interfaces
Collaborative User Interfaces are part of collaborative environments and applications and are establishing a human to human collaboration regarding the three aspects communication, coordination and cooperation, which is also known as 3C-Model [4]. COUI can be found in diverse application functional classes [4]; e.g. Message Systems, Multi-User Editors, Group Decision Support Systems, Electronic Meeting Rooms, Computer Conferencing, Intelligent Agents, Workflow Management Systems and more. Depending on the purpose COUI are supporting each of the 3C differently [12].

PARALLELS OF SUI AND COUI
At first glance SUI and COUI seem to have few similarities based on their purpose. The purpose of the SUI is to help

the user to understand what is happening and give a better control while the COUI focuses on supporting the user while performing shared tasks with other users.. To show the similarities of both a few examples are described subsequently. Thereafter a conclusion for the presented examples will be drawn in the following section.

Adaptation of a Workspace

A shared workspace is a common tool in Collaborative Environments (CE) [8][6] but team members normally have different preferences, different experiences, and often different training thus making adaptations necessary [11]. If a team member is changing the workspace layout in a way which is affecting all of the team (e.g., removing an important tool) the change has to be communicated and explained to be excepted by the team or at least the team has to be made aware of the change if a more hierarchical role concept is used. Likewise in a self adapting system (SAS) which is controlling a workspace environment adaptations of the workspace (removing a tool because of resolution changes) have to be communicated and explained to the user.

Simultaneous changes by the user and the system

Typically the work in CE takes place on some kind of shared business objects [11] which demands coordination of activities for conflict prevention or concurrency control to resolve conflicts between participants simultaneous operations [4]. In a SAS the user is sharing interface objects with the system. In example if the system decides to optimize the content of a toolbar at the same time the user is customizing it, this leads to a conflicting state. Either the user can get her privileges to change the toolbar revoked on short-term by the system to prevent conflicts or the system has to resolve emerging conflicts with a suitable solution. A simple one could be to overrule the users changes. Both the SUI and the COUI have to provide the appropriate coordination and concurrency control mechanism to minimize user confusion and disturbance along with suitable application control.

Application Tutoring

In CE colleagues may serve as tutors for inexperienced colleagues by guiding the first steps with tools provided by the environment (e.g., mouse traces can be followed, questions can be asked and are answered by others via chat etc.) This cooperation towards a goal with a common interest (in this case the same skill level for optimal working results) can be transferred to SAS or SUI respectively. The system and the user are sharing the common interest that the user can operate the application at best and therefore has to provide a SUI which enables cooperation towards this goal between the user and the system. To achieve this goal the SUI should be able to act as tutor for the user.

IMPLICATIONS FOR SUI FROM COUI

As shown by the examples in the section above system behavior triggered by an agent (whether that agent is automation or another human) establishes the same requirements upon the user support. Furthermore the aspects of communication, coordination and cooperation (3C), which are used to characterize collaborative applications can be found in the concept of SUI, with the difference that for SUI the user is collaborating with the system instead of a human.

For collaboration environments different classifications exist. In the context of SUI the 3C Model proposed by Teufel et al. [12] can be utilized to classify SUI respectively by weighting the support of each of the 3C within the system separately. The system can be classified by placing it in a triangle where each corner represents one of these properties as shown in Figure 1 (exemplary illustrated for [9][2][5] and a fictive Automation Level Configurator which allows the user to adjust the automation level of adaptations with guidance to find the optimal personal configuration).

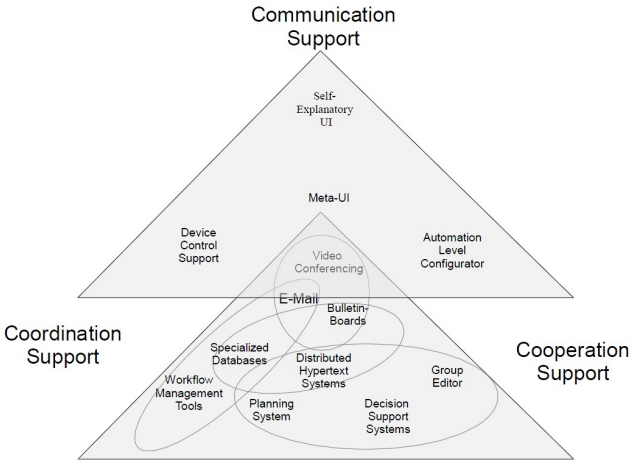

Figure 1: exemplary SUI 3C Classification based on[12]

The advantage of this classification is that both COUI and SUI become comparable. Furthermore, this can help to find design issues in SUIs. In a smart home for example the steering of activities of multiple users which may depend on shared device resources can be supported by SUI functionality with the goal to optimize daily routines and to avoid resource conflicts. This SUI with the focus on Device Control Support can inherit aspects and mechanisms of Workflow Management Systems because resource allocation and scheduling are fundamental issues of them [3].

Another benefit from considering collaborative aspects in SUI while designing interfaces is that parts of the UIs supportive functionality can be replaced later on by real collaborative functions if desired. Humans still tend to trust humans more then machines especially when life or money is involved. The configuration interface of an automated heating regulation system in a smart home for example can be either explained by the system itself or the user seeks the guidance of a human supervisor by switching to the collaborative mode. A fundamental issue of SUI amongst

others therefore should be to support the user to get support, whether this support can be realized by the system itself, another system or other users.

CONCLUSION & OUTLOOK

In this paper the parallels between SUI and COUI have been shown; both share the aspects of communication, coordination and cooperation and are establishing the same requirements on the user support. Furthermore SUI can be classified with the help of the 3C Model likewise COUI. This classification can help to identify and to focus on design issues for SUI by considering related COUI implementations.

One can assume that a quality level of SUI could be how close the system is behaving in comparison to a real user within a similar collaborative environment. The specification of quality levels has to follow the clear specification of SUI and is therefore a interesting topic for future research.

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