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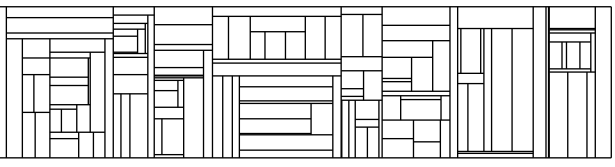

Content

Doctoral Colloquium papers

DUET 2011
Dual Eye Tracking in CSCW

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Abstract. Dual eye-tracking (DUET) is a promising methodology to study and support collaborative work. The method consists of simultaneously recording the gaze of two collaborators working on a common task. The main themes addressed in the workshop are eye-tracking methodology (how to translate gaze measures into descriptions of joint action, how to measure and model gaze alignment between collaborators, how to address task specificity inherent to eye-tracking data) and more generally future applications of dual eye-tracking in CSCW. The DUET workshop will bring together scholars who currently develop the approach as well as a larger audience interested in applications of eye-tracking in collaborative situations. The workshop format will combine paper presentations and discussions. The papers are available online as PDF documents at http://www.dualeyetracking.org/DUET2011/.

Program, Sunday September 25th, 2011

9:00 – 9:15 Welcome

9:15 – 10-15 Session 1: Methodology

Mobile Dual Eye-Tracking Methods: Challenges and Opportunities
Alan T. Clark and Darren Gergle. Northwestern University, USA

Unravelling cross-recurrence: coupling across timescales
Patrick Jermann and Marc-Antoine Nüssli, Ecole Polytechnique Fédérale de Lausanne, Switzerland

10:15- 10:45 Break

10:45 – 12:30 Session 2: Studies of coordination

Following closely? The effects of viewing conditions on gaze versus mouse transfer in remote cooperation
Romy Mueller, Jens R. Helmert, Sebastian Pannasch and Boris M. Velichkovsky
Technische Universitaet Dresden, Germany

How two people become a tangram recognition system
Rick Dale, The University of Memphis USA
Natasha Z. Kirkham, Birkbeck, University of London, UK
Daniel C. Richardson Cognitive, University College London, UK

Gaze matching of referring expressions in collaborative problem solving
Naoko Kuriyama, Asuka Terai, Masaaki Yashura, Takenobu Tokunaga, Kimihiko Yamagishi, Tokyo Institute of Technology, Japan
Takashi Kusumi, Kyoto University, Japan

Using metaphors in collaborative problem solving: An eye-movement analysis
Asuka Terai, Naoko Kuriyama, Masaaki Yasuhara, Takenobu Tokunaga and Kimihiko Yamagishi, Tokyo Institute of Technology, Japan
Takashi Kusumi, Kyoto University, Japan

12:30 – 14:00 Lunch

14:00 – 15:00 Session 3: Applications

Cognitive Processes during Collaborative Learning from Text and Pictures
Krista E. DeLeeuw, Katharina Scheiter and Friedrich Hesse, Knowledge Media Research Center, Tübingen, Germany

Gaze cursor during distant collaborative programming: a preliminary analysis
Roman Bednarik, University of Eastern Finland, University of Pittsburgh, USA
Andrey Shipilov, University of Eastern Finland

15:00- 16:00 Discussion

CSCW^{Smart}? Collective Intelligence and CSCW in Crisis Situations

Preliminary Programme

1st September: Background readings, draft papers (9th September) and videos in a wiki

23rd September: Dinner in town for those already here

24th September

09:00 *Coffee*

09:30 *Introductions*

09:45 **Collective Intelligence in Crises** (Monika Büscher, Gerd Kortuem & Jon Whittle)

10:15 **Where to draw the line? Approaching a scale to negotiate in-situ civil involvement for the inquiry of crisis information** (Amro Al-Akkad, Rene Reiners, Marc Jentsch)

10:45 *Coffee*

11:15 **A real-time social media aggregation tool: reflections from five large scale events** (Jakob Rogstadius, Vassilis Kostakos, Jim Laredo, Maja Vukovic)

12:30 *Lunch*

13:30 **Supporting transactive memory networks through information brokering** (Tom Duffy, Chris Baber)

14:00 **The role of social media in emergency preparedness and response in the UK** (Maria Ferrario)

14:30 **TBA** Leysia Palen

15:00 *Coffee and cake*

15:30 Group Discussions (Small Groups)

16:30 What next?

19:00 Dinner

Participants

Al-Akkad, Amro, Fraunhofer Institute of Applied Information Technology, Germany

Buscher, Monika, Sociology, Lancaster University, UK

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Ferrario, Maria, Computing, Lancaster University, UK

Jentsch, Marc, Fraunhofer Institute of Applied Information Technology, Germany

Kortuem, Gerd, Computing, Lancaster University, UK

Palen, Leysia, Computer Science, University of Colorado, Boulder, USA

Reiners, René, Fraunhofer Institute of Applied Information Technology, Germany

Rogstadius, Jakob, M-ITI University of Madeira, Portugal

Schorch, Marén, Sociology, Bielefeld University, Germany

Whittle, Jon, Computing, Lancaster University, UK

This workshop is supported by the *Bridge* Project (EU FP7, http://www.sec-bridge.eu), the *Citizens Transforming Society: Tools for Change* (CaTalyST) Project (EPSRC, UK), *Next Generation Resilience Project 'DFuse'* (EPSRC) and the *Communicating Disasters* Programme at the Centre for Interdisciplinary Studies, ZiF (http://www.uni-bielefeld.de/ZIF/FG/2010CommunicatingDisaster/), Bielefeld University, Germany.

Improving Situational Awareness in Emergencies through Crowd Supported Analysis of Social Media

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Abstract. In this ongoing research project, we develop an information system that aims to improve situational awareness and shorten response times in emergency response situations. Through a combination of algorithmic and crowdsourcing techniques, the proposed system gathers, analyzes, organizes and then visualizes social media activity around an event in real-time and turns overwhelming streams of status updates into actionable pieces of information. This document is an extended abstract to the poster with the same name.

Social media in emergency response

Successful emergency response relies heavily on situational awareness, created from access to timely, accurate and relevant information about complex ongoing events. As a complement to traditional sources, researchers (Vieweg et al. 2010) and emergency response professionals (van der Vlugt and Hornery 2009) are now identifying social media as an emerging source of early breaking news, image and video footage, and an indicator of where to direct resources. However, existing information systems either fail to incorporate social media as a source, or do not meet the requirements imposed by use in crisis situations.

Algorithms vs. crowdsourcing

There are currently two main approaches for building real-time information systems. Purely automated news aggregators, such as EMM NewsBrief (Piskorki et al. 2008), already perform quite well at the task of gathering and clustering articles related to an event, including extracting metadata such as locations, people and quotes from the clusters. However, these systems offer generic approaches that are unable to gather and present knowledge in a manner tailored to the characteristics, needs and priorities of a specific event or disaster. Although social media aggregators exist, we are unaware of any that offer functionality and performance on a level similar to those for news.

Other systems more specialized for emergency use, such as Ushahidi (www.ushahidi.com), adopt an almost purely crowdsourced approach by relying on individuals to submit reports containing all necessary metadata; data which is then presented using default or in some cases event-adapted interfaces. While these systems are designed to be much more adaptive than the news aggregators, they are instead unable to integrate the vast but largely unstructured knowledge base related to a particular disaster that is social and traditional media.

Our contribution

The limitations of both fully automated and fully crowdsourced information processing systems motivate the need for solutions that combine the scalability of algorithmic computation, with the unique human capabilities to adapt to new situations, prioritize information, infer knowledge, estimate trust and question sources. Our proposed system (see poster) handles this by integrating crowdsourcing into an architecture of machine learning and NLP techniques, to analyze and structure social media content posted by microbloggers and service users during an event or disaster. The system is a work in progress and current functionality consists of topic tracking, message clustering, breaking news detection, an event timeline and drill-down functionality to read individual tweets.

References

Piskorski, J., Tanev, H., Atkinson, M. and van der Goot, E. (2008): 'Cluster-Centric Approach to News Event Extraction'. *In Proceeding of the 2008 conference on New Trends in Multimedia and Network Information Systems*, IOS Press, 2008, pp. 276-290.

Vieweg, S., Hughes, A., Starbird, K. and Palen, L. 'Microblogging during two natural hazards events: what Twitter may contribute to situational awareness'. In *Proc. CHI 2010*, ACM Press, 2010, pp. 1079-1088.

van der Vlugt, M., Hornery, A. (2009): 'Social Media helping Emergency Management – Final Report'. *NGIS Australia*, 2009. http://gov2.net.au/files/2009/12/Project-14-Final-Report.doc

Plans at the workplace: planning the use of the apron in an Italian airport

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Research description. Ethnographic research (Randall *et al*., 2007) that takes place in the apron tower of an Italian airport.

The apron tower is a communication centre for the coordination (Suchman, 1997) of the activities, which take place on the apron. The apron is a well-defined area next to the runway where aircrafts are parked and where handling activities take place. In order to successfully handle each aircraft the apron personnel have to:

1. plan in advance where to park each vehicle (considering, among others things, the aircrafts dimensions, the manoeuvres necessary in order to move the aircraft out of the parking area, the typology of each flight –charter or freighter-, passengers' safety and security);
2. be able to detect in advance if the solutions planned in earlier are still useful despite for example, a flight delay;
3. correct the plan if necessary.

Corpus of data. The research is still at a relatively early stage. It and has so far involved the collection of data over a period of two months. Data are collected by means of direct observation. Conversations among operators in the control room will be taped and the apron tower personnel will be interviewed.

Research and the CSCW community. The research is focused on the character of plans in the apron tower. My aim is to contribute to the discussion on plans and situated actions in the CSCW community (Button, Sharrock, 1994; Bardram, 1997; Schmidt, 1999; Dant, Francis, 1998; Koskinen, 2000; Rönkkö *et al*., 2005; Harper *et al*., 2000) with my analysis on how the use of the 'apron' in an Italian airport is planned.

Suchman's work on plans and situated actions (1987) has mistakenly introduced a contrast between the plan as a representation of situated actions and actions as *ad hoc* improvisations. Nevertheless several studies in the last twenty years in the CSCW community have shown that the false dichotomy between plans and situated actions can be removed.

Bardram suggests that it is possible to talk about *situated planning* (Bardram, 1997) as plans themselves are realised *in situ* in that they are made out of situated actions.

Rönkkö *et al*. (2005) instead have highlighted that 'plans "necessarily" underdetermine situated actions' because 'no rule dictates its own application' (p. 436).

Originality of research.

1. The research describes a centre of coordination which carries out a particular activity not yet fully described in the area of CSCW studies (but see Goodwin and Goodwin, 1996)
2. Research could be of interest from a methodological point of view, as my intention is to show how structures in the environment, interactions evolving over time, talk and non-talk activities affect communication as it plays a central role in the plan building and revising
3. The study is of interest because it is closely connected with safety in airports

How results promise to advance. The work will contribute:

1. to the understanding of the particularity and complexity of the planning activity carried out by the personnel of the apron tower
2. to a corpus of studies on controlling work, with the aim of generating a stable set of features which can be used for comparative purposes. The research might allow us to understand both what the general and more specific elements of controlling work look like.

Teaching support system for the group collaboration in the asynchronous learning environments

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Demos and Videos.
ECSCW 2011, September 24–28, 2011, Aarhus, Denmark.

Abstract
Presently, information literacy education is being imparted at many universities. However, it is difficult for teachers to manage the student group in asynchronous learning environments. We designed a support system that encourages smooth and active communication. Our system reduces the burden on teachers using functions based on network analysis.

Keywords
CSCL, group collaboration, electronic bulletin board system, network analysis

ACM Classification Keywords
H.5.3 Group and Organization Interfaces-Computer-supported cooperative work

Introduction
Presently, information literacy education is being imparted as part of the curriculum for freshmen at many universities. An effective method for cultivating information literacy skills is group collaboration (for instance, through problem-based learning (PBL) [1]). However, in group collaboration, students often have to work and indulge in discussions after class hours in an asynchronous environment, which makes it impossible for teachers to manage the students group.

Asynchronous collaborative learning

The outline for group collaboration in an asynchronous environment is shown in Fig.1.

figure 1. Group collaboration in an asynchronous environment

An electronic bulletin board system is a useful tool for group collaboration in an asynchronous environment. Students can conveniently use the electronic bulletin board system for work and discussions. However, it is difficult for teachers to effectively manage the students' work because the individual participants and entire groups can be either active or passive on the bulletin board. Hence, to effectively manage the student group, it is necessary for the teacher to easily grasp the group's and participants' states.

Teaching support system for the group collaboration

From our previous research [2][3], we found that visualizing the relationships between the topics and the students as well as the relationships between keywords and utterances serves as effective support for a teacher. Accordingly, we propose two functions to visualize the state of group communication in an electronic community using the principles of network analysis. Our system analyzes the records of group communication and accordingly devises network diagrams. The outline of our system is shown in Fig.2.

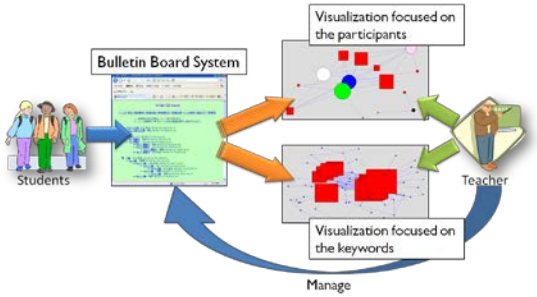

figure 2. The outline of our system

Visualization focused on the participants

To represent the relationships between the topics and the participants, our system draws network diagrams focused on the participants. A node of each topic is linked with the nodes of the participants.

Visualization focused on the keywords

To represent the relationships between the keywords and the utterances, our system draws the network diagrams focused on the keywords. A node of each utterance is linked with the nodes of the keywords.

Example citations

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[2] Shinozawa, Y., Uetake, T. A Study of the BBS Communities which Assist Practice Classes by Using Network Analysis, Journal of the Japan Society for Management Information, Vol. 15, No.2(2006), pp. 1-22. (In Japanese).

[3] Uetake, T., Shinozawa, Y. A Design of the Support System for the Group Collaboration to Cultivate Information Literacy Skills, 13th International Conference on Hu-man-Computer Interaction (2009).

3D Video Conference system using fused images Display to Replicate Gaze Direction.

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Demos and Videos.
ECSCW 2011, September 24–28, 2011, Aarhus, Denmark.

Abstract
We propose a new video conference system based on a novel 3-D display that replicates the eye contact back channel available to the attendees of real conferences. The 3-D display consists of multiple screens that replicate the participants' face direction in presenting their faces. The key innovation of the display is shifting the relative positions of the face and eyes to replicate the participant's gaze direction. We introduce a prototype video conference terminal with two screens and demonstrate that it can well replicate face and gaze direction.

Keywords
Video Conference System, 3-D display, DFD

ACM Classification Keywords
H.5.3 Information Interfaces and Presentation: Group and Organization Interfaces—synchronous interaction

General Terms
Design, Experimentation

Introduction

We propose a video conference system that can enhance the connectivity of remote participants by exchanging face and gaze direction so as to establish the back channel modality of eye contact, see Figure 1. Gaze direction is important not only to indicate the intended speech recipient, but also to transmit delicate changes in feeling and interest. The combination of a single camera and ordinary 2D displays is unable to replicate gaze direction due to the Mona Lisa effect. That is, each participant feels that all other participants are looking at him/her. Moreover, it is not possible for a participant to single out a particular participant as the recipient of his/her gaze because all other participants' faces are shown side by side on the screen. This paper describes a two-image display system for replicating face and gaze direction. A prototype is introduced and shown to achieve eye contact with directivity. Subjects could well discern eye contact when the remote participant look to the front as well as to either side.

Related Work

Humans naturally expect to perceive the modalities of verbal and non-verbal communication when conducting a conversation. Gaze and face direction are especially important components of the latter. Participants can know the speech's intended recipient and the person of interest from gaze and face direction.

Many studies have tackled eye-contact support in multi-party video conference systems([3],[4],[6]). These systems attempt to create 'natural images' by placing the camera as close to the central axis of the display as possible. Technical solutions include special screens and half-mirrors. However, these systems enable correct eye-contact agreement only for the participant whose virtual position is directly in line with the screen.

More recent studies use the technique of displaying different images at different directions ([2], [1]). However, device and operating costs are impractically high for a reasonable number of directions.

Figure 1: Image of intended use

Representation Method of Face direction

We have developed a 3D image that fuses layered images in the same way as DFD([5]). This paper generates two 2D images of the participant's head. The front image covers the face back to a plane just in front of the ears. The back image covers the remainder of the head, see Figure 2. When these images are displayed on spatially separated (in terms of depth on the viewing axis) screens, a 3D image is perceived if they overlap from the viewer's position. In Figure 2, User A feels that the face displayed on the screen is directed to him, because the two images overlap perfectly for user A. On the other hand, user B feels that the face is turned slightly to the right; due to parallax, the centers of the front and rear im-

ages are offset. User B unconsciously fuses the two images which triggers the effect of head turning.

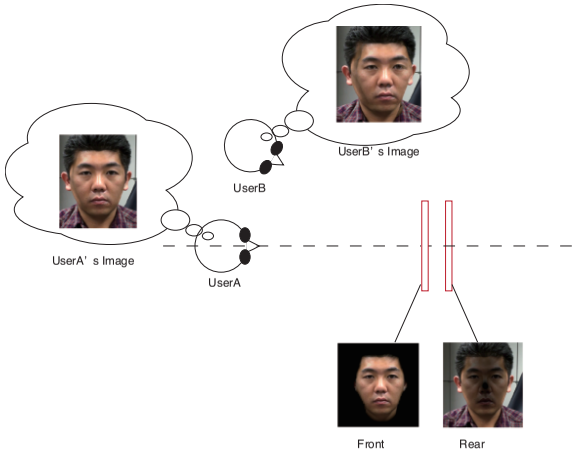

Figure 2: Gaze and face direction replicated by 3D image

Prototype System

We designed a prototype system for small-scale conferences. Since the participants are separated by short distances and they can see each other's faces well, gaze and face direction will have a strong influence on discussion progress. The prototype terminal, see Figure 3, was placed on the table to stand in for the remote participant.

Experiment and Result

The rotation of screen was controlled by the subject using a mouse. The subject was instructed to stop if he/she felt very strongly that the face on the display was looking directly at him/her. When the eyes of the subjects in the test movies were directed to the front, the subject stopped the left edge and right edge while he/she felt that the face was looking directly at him/her. The results of the experiment in which the eyes were moved are shown in Figure 4. Most subjects felt that he/she was the recipient of eye-contact if the eyes moved within the range of -4.7/4.7 [degree] on the screen. This indicates that subjects were able to recognize the gaze direction and he/she was the recipient of eye-contact on the same side. i.e. when the eyes on the screen moved to 4.7 degree, he/she was the recipient of eye-contact if he/she were on the right side of the face on the screen.

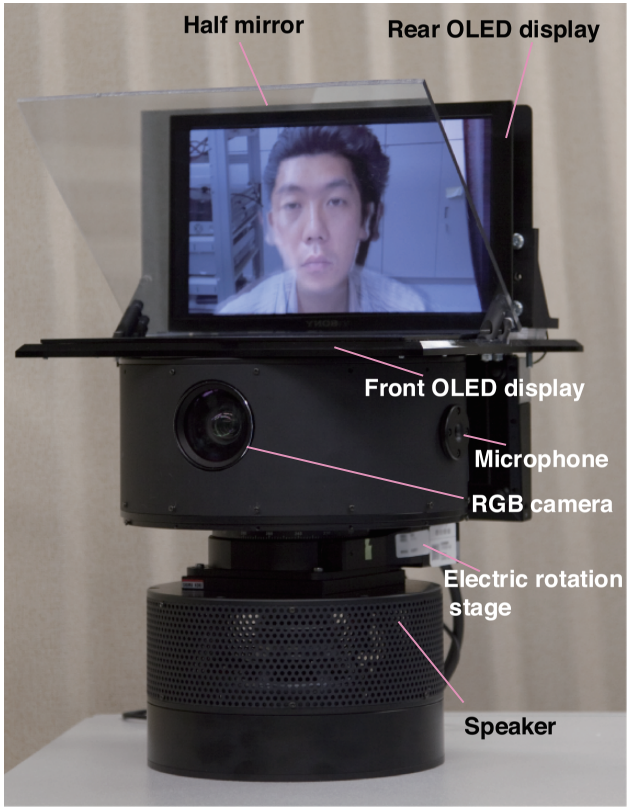

Figure 3: Prototype terminal

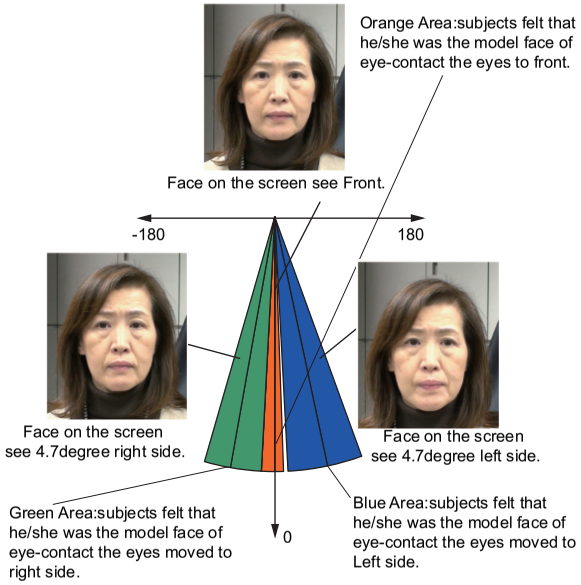

Figure 4: Experiment result

Conclusion

We have described a new video conference system that can provide remote participants with the back channel information of eye contact. We proposed a special display that visually fuses two 2D images to create a 3D image that replicates the direction of the participant's face. In addition, the screens replicate the participants' gaze direction from the relative positions of the face and eyes. The method proposed herein was tested in experiments. We have developed and tested a prototype video conference system based on visual fusion.

References

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SOGATO: A Social Graph Analytics Tool

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Demos and Videos.
ECSCW 2011, September 24–28, 2011, Aarhus, Denmark.

Abstract
This demonstration paper describes the first version of SOGATO, a social graph analytics tool. SOGATO is a research prototype that utilizes the facebook Open Graph API to query, store, compute and visualize several socio-technical interactional metrics and trends within one or more facebook walls. Technical implementation details are presented accompanied by a screenshot of the homescreen and an analytical example from the political sphere in Denmark. Future directions for development are outlined in conclusion.

Keywords
Computational social science, social networking analysis, facebook studies, social graph

ACM Classification Keywords
H.5.3 [Group and Organization Interfaces]: Collaborative computing, Computer-supported cooperative work.

General Terms
Design, Human Factors, Management, Measurement.

Introduction
Online user participation in and engagement with social media in general and social networking in particular is a growing trend. For example, the Pew Research Center's Internet & American Life Project has found that:

> 75% of all American adults are active in some kind of voluntary group or organization and internet users are more likely than others to be active: 80% of internet users participate in groups, compared with 56% of non-internet users. Moreover, social media users are even more likely to be active: 82% of social network users and 85% of Twitter users are group participants. (The Social Side of Internet Report[1])

The online users' participatory turn and the resulting social side of the internet as a phenomenon applies equally to Denmark where the social networking site, facebook is now regarded as the largest media with an user base of 47.06% of the total population and 54.64% of the online population[2].

Originality and Contribution

Taken together, these socio-technical trends of increasing online group work and social networking poses a unique challenge to the traditional conception and analytical focus of CSCW on enterprise systems in formal organizational settings. As such, we need to study new emergent forms of cooperative work that are supported by social networking sites such as facebook and micro-blogging sites such as twitter. In this paper, we present an early research prototype social graph analytics called SOGATO. The primary purpose of SOGATO is to query, store, retrieve, compute and visualize socio-technical interactions on facebook walls with data from social media channels such as twitter and youtube to be included later versions.

[1] http://pewinternet.org/Reports/2011/The-Social-Side-of-the-Internet.aspx
[2] http://www.socialbakers.com/facebook-statistics/denmark

Related Work

There are several social media analytics tools available for commercial use (e.g., SAS[3], Radian6[4]) as well as academic use (e.g., TubeKit[5], NodeXL[6]). SOGATO differs from existing tools in the sense that it seeks to support exploration and discovery of emergent forms of CSCW interactions in social media from a computational social science perspective [1].

SOGATO: Technical Description

This section briefly describes the method, data source and technologies used to retrieve the posts from facebook wall and the transform information to display as graphs to depict statistics in a meaningful way. SOGATO can retrieve the posts from facebook walls and then store all the posts in a database and then the stored information is used to generate statistics resulting in graph displayed on the web form.The tool is developed using C#, ASP.NET, Html and MsSql database as a database at the backend.

Datasource and capture

Every facebook user/wall gets assigned a unique ID and that unique ID is used to identify the wall by the tool. User from a web interface provided by the tool inserts the unique id and triggers the command to either retrieve all the posts from a given wall or posts from the wall can be retrieved for a given time period . To fetch the posts from the facebook wall an publicly available application program interface (API) named

[3] http://www.sas.com/software/customer-intelligence/social-media-analytics/
[4] http://www.radian6.com/
[5] http://www.tubekit.org/
[6] http://nodexl.codeplex.com/

Graph API[7] is used that can natively work in conjunction with C#[8]and with the help of unique wall ID provided certain commands can be issued and posts are retrieved in a uniform java object format that is known as JavaScript object notation (JSON)[9] and that data format again has a native support from C# and after little parsing and data conversion efforts the posts can be transformed in C# objects. And then with the help of Microsoft ADO.NET technologies[10] a pipe towards the backend data source is created and all the posts are stored in the database. There can be four types of posts at the facebook wall that are status, link, video and photo and every post on the wall can have further likes and comments and hence to make it possible that detailed analysis can be performed, SOGATO also stores not only the total number of likes but also the facebook ids and names of the persons who liked the post and as well as all the comments posted on any given post and the actual comment as well. Just like every wall in the facebook sphere every post also gets assigned a unique ID that can be used to fetch Likes and comments for the chosen post with the help of GraphAPI. Some notable information stored in database from posts is as follows:

- FacebookID (A unique ID in the facebook world per wall)
- Type (Type of the post)
- Link (In case of Link type a link is retrieved and stored in the database)
- FromID (ID of the person who posted on the wall)
- Likes count (Total number of likes for given post)
- Created date (The timestamp when the post got created)
- Message (Actual message posted)

For the "likes" to a given post, the following information is stored:

- Facebookid (Unique id of the person who liked the post)
- Name (name of the person who liked the post)

For "Comments" posted on a given post, the following information is stored:

- Facebookid (Unique Id of the commenter)
- Name (Name of the commenter)
- Message (Message that was posted as comment)
- Createddate (Time stamp when the comment was posted)

Descriptive Statistics: Generation and Visualization

SOGATO provides the features to generate statistics for one or more walls at the same time and statistics can be generated with for all the posts stored in the database or a time span can be defined to retrieve only the information for that time period. MS SQL queries are used to group the data available relying on the ids of the wall, posters, the posts, the likers and commenters. The transformed information is then passed on from database to the web part of the tool that further transforms information into objects that are compatible with a graph generator .To present the information in graph an add on named Microsoft Chart Control[11] is used. This control can present information in many types of graphs including bar and pie charts. If information is provided in correct grid format (X and Y Axis) then output can sophisticatedly be rendered as a

[7] http://developers.facebook.com/docs/reference/api/
[8] http://facebooksdk.codeplex.com/documentation

[9] http://www.json.org/

[10] http://msdn.microsoft.com/en-us/library/ms227647(v=vs.90).aspx

[11] http://www.microsoft.com/downloads/en/details.aspx?FamilyID=130f7986-bf49-4fe5-9ca8-910ae6ea442c

graph on a simple html page that can be seen on any web browser readily available.

SOGATO: Screenshot

Figure 1 presents the home screen for SOGATO.

Figure 1: Home screen of SOGATO used to fetch facebook walls to the data

SOGATO: Illustrative Example

Figure 2 presents the descriptive statistics for the facebook wall posts for two Danish politicians.

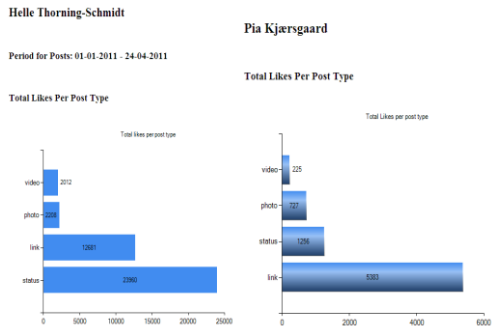

Figure 2: Distribution of likes across the four posting types for two different facebook walls

A preliminary observation from Figure 2 is that the distribution of likes across the different wall post types of links and status updates varies between the two Danish politicians, Helle Thorning-Schmidt and Pia Kjærsgaard. Helle has more likes for wall postings of status updates while Pia has more likes for wall postings that share internet links. What, if any, are the engagement differences due to this "like" behavior difference is an open empirical question we seek to study further. This illustrates the exploratory and discovery work we hope SOGATO will support.

Future Directions

SOGATO is admittedly at an early development stage. From a research perspective, our objective is to support exploratory and discovery analytical work with SOGATO and this will the focus of the future work.

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Demonstration of a research prototype of a collaborative planning tool for use in offshore petroleum operations

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Demos and Videos.
ECSCW 2011, September 24–28, 2011, Aarhus, Denmark.

Abstract
A specialized tool for supporting co-located planning sessions in the support center for an offshore petroleum installation is demonstrated. The prototype is grounded in a user-centered design process, and has been designed to enable tighter interdisciplinary collaboration on complex re-planning problems.

Keywords
Large screen, multi-touch, information visualization, collaboration, interaction design, industrial case.

ACM Classification Keywords
H.5.3 [Information interfaces and presentation]: Group and Organization Interfaces

General Terms
Design

Introduction
Many complex work domains are exploring how technology may be used to enable more efficient collaborative work practices. "Integrated Operations" is an emerging operation paradigm in the petroleum industry that relies on videoconferencing and other

generic collaboration tools to connect onshore and offshore sites and restructure work processes. Another trend is that data from different underlying systems are being integrated and connected to more flexible and sophisticated end-user interface systems. This development creates opportunities for a new generation of tools to emerge. Rather than being structured according to underlying systems and geographical locations, such tools may be built around the desirable work processes. These are typically highly specialized, dynamic, data-intensive and interdisciplinary in nature. As part of a large multi-disciplinary research effort in this area, our research explores the role of interaction design in creating specialized collaboration tools that can support novel, interdisciplinary work practices in this domain.

Description of the prototype

We have developed a specialized tool for supporting co-located planning sessions in the support center for a large offshore petroleum installation. The prototype is an Adobe AIR application intended for use on a large, multi-touch surface. Its core functions include an interactive timeline for planning and dynamic rescheduling, coupled with information visualization features that allow easy exploration the complex logistical constraints. The tool also allows construction of alternative scenarios and comparison of their consequences.

Touch-based interaction is used as an intuitive means of interaction for the individual user. We also believe that touch is beneficial for the overall "collaborative user experience" as the touch interactions serve as effective communicative gestures and thus improve users' awareness of each others actions.

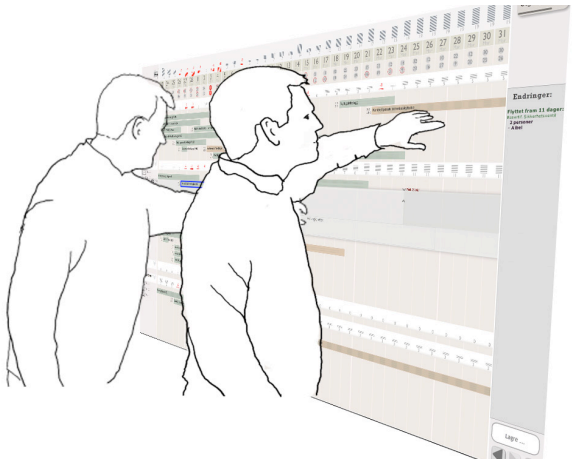

Figure 1: Envisioned use of the prototype on a large multi-touch surface.

Our point of departure differs from the growing body of research on large multi-touch surfaces and tabletops that primarily explores the use of this particular technology. Using a research-through-design approach, we did not let particular technologies or theoretical frameworks frame our early problem exploration or the formation of solution concepts. Instead, it was an open-ended problem exploration process into the empirical reality of our industrial case that led to the concept explored in the current prototype.

The use of multi-touch interaction, the type of surface and its physical configuration are therefore only a few of the conceptual layers in the design on which we have tried to create affordances for collaboration. The information content has been selected to satisfy information requirements of the different disciplines, and different types of information has been carefully

integrated. New visual forms have been designed to work across disciplinary boundaries, and interactions are designed to be simple, effective and easily perceivable for co-users. The overall physical configuration has been designed to accommodate the relevant team size of 2-4 people using a 65-inch vertical multi-touch surface.

The demonstration here will be restricted to a 24-inch surface. This will allow participants to experience many aspects of the design and user experience of the prototype, but some of the immersive and collaborative qualities of the full-scale prototype experience are obviously absent in this smaller scale version. However, video will be used to show teams using the full-scale prototype. Some background material will also be presented to clarify the industrial context for those who are unfamiliar with this particular setting.

Design process

The prototype demonstrated here is the result of an extensive user-centered design process that paid special attention to integration of the perspectives of the different professional disciplines whose interests and concerns intersect in the planning process.

A special design documentary film was created to capture interdisciplinary collaborative demands and to support further dialogue with end-users and other relevant stakeholders [1]. This provided rich input to the following design phase, in which four design concepts were explored in a video prototype where we envisioned how novel solutions might help transform the work processes. The direction of the intended transformation of work practices was also based on our effort to grasp and concretize new organizing concepts in the industry. Our design aspires to induce new practices better aligned with such high-level managerial visions and perspectives, while also resonating with the end-user perspectives.

Current practices involve painstaking manual integration of information across multiple systems and tools, such as enterprise and industry-wide database and ERP systems, project management tools, as well as complex user-created spreadsheets. The sort of solution we explore in the current prototype therefore represents a radically novel approach, even for this high-tech industry.

Evaluation process

As our strategy for evaluating this rather complex design product, we have chosen to collect feedback from several types of sources, each focusing on certain aspects or qualities of the design.

A design critique workshop with other interaction designers in this field helped articulate more clearly the ideas of the prototype, point out potential flaws and anticipate important issues for later end-user evaluations. We also used mock-up techniques to explore the requirements to the size and physical configuration of an appropriate large multi-touch screen.

The next step was an evaluation session with specialized end-users, held in their own work environment. This session focused primarily on the real-world usefulness and relevance of the ideas presented in the prototype.

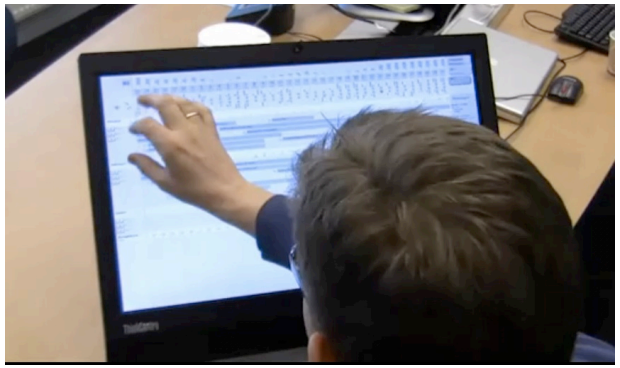

Figure 2: Evaluation session with specialist end-users testing the prototype on a 24-inch surface. This smaller surface was used in development and does not provide the full collaborative user experience.

We received important feedback on the scope, level of detail, etc. of the prototype. Key assumptions behind the design were also confirmed, such as the relevant target team size being 2-4 people. The overall feedback was a general approval from all the participants, who saw the concept as a relevant and promising response to their work demands.

The next major step will be a larger controlled study where teams of non-specialists will use the prototype on a large, high-quality multi-touch surface to perform collaborative problem-solving tasks. The purpose of this study is to collect more detailed data on usability issues. This will cover the traditional individual-user perspective, as well as explore issues related to the collaborative use of the prototype in particular ("team usability").

We also plan to further assess the usefulness dimension through dialogue with other types of stakeholders in this business.

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A Modified Google Docs UI accessible via screen reader

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Abstract
Collaborative editors are simple tools that enable people to create, share and exchange documents via Internet, quickly enhancing learning, knowledge and socialization. However, at present collaborative software is designed with little attention to the needs of differently-abled persons, such as the blind. Dynamic user interfaces and visual features delivering meaning may be inaccessible via screen reader, if an appropriate design is not adopted. In this demo we show a prototype of some modified Google Docs User Interfaces (UIs) -- for accessing and editing a document -- that allow full accessibility via JAWS screen reader. An interaction with the original and modified UIs is shown to highlight barriers and possible solutions for their elimination.

Keywords
Collaborative editing, Google Docs, Accessibility, usability, blind, screen reader

ACM Classification Keywords
H.5.2 [Information Interfaces and Presentation]: User Interfaces – Graphical user interfaces (GUI). K.4.2 [Social Issues]: Handicapped persons/special needs.

General Terms

Algorithms, Design, Human Factors

Introduction

Collaboration is the basis for many activities such as learning, working and playing. Several studies state the efficacy of cooperation and collaboration regarding learning [5], [2]. Collaborative tools are a great opportunity for students and should be accessible and easy to use for all, including people with disabilities. Google Docs is a widely used Web tool that allows one to work on different kinds of files, such as documents, spreadsheets and presentations, in a real-time collaborative way. In previous studies, we analyzed interacting via screen reader (an assistive technology used by visually impaired people along with a voice synthesizer) with the Google Docs environment and found some accessibility and usability issues [6]. We have developed a prototype of the Google Docs environment (focusing on the collaborative editing of a word processing document), which by improving the accessibility of the UI enables a better interaction experience for blind users (via screen reader access).

Related Work

Cooperative environments are particularly useful in the educational field, where cooperatively assembled knowledge enhances learning. Khan et al. [3] performed a usability study with four novice and four experienced users in an educational environment, comparing ThinkFree (a collaborative writing system) with Google Docs. Authors found that although ThinkFree proved effective for the proposed tasks, efficiency and availability of resources were more limited than in Google Docs.

Schoeberlein et al. [8], revising recent literature on groupware accessibility solutions, observed that most studies focus on a specific category of differently-abled persons: the visually-impaired. To simplify access to a popular groupware system (Lotus Notes), Takagi et al. developed a self-talking client that allows blind people to access the main functions of Lotus Notes efficiently and easily, masking the complexity of the original visual interface from the user [9]. Kobayashi developed a client application (Voice Browser for Groupware systems, VoBG) to enable visually impaired persons who are inexperienced with computer technology to interact with a groupware system, Garoon 2, very popular in Japan. The browser intercepts Web pages generated by the groupware server, parses their HTML code and on-fly structures content in a more accessible format [4].

Baker et al. adapted Nielsen's heuristic evaluation methodology to groupware, showing that usability inspection can also be effectively applied by novice inspectors, at low cost [1]. Ramakrishnan et al. [7] investigated usability assessment in "information management systems", groupware environments characterized by users' asynchronous usage, integrating and adapting Nielsen's usability heuristics.

Awareness, one of the main properties of a groupware system, is one basic accessibility principle: the user must be able to perceive via the screen reader UI all dynamic changes and events (e.g. a new person joining the chat, a new message arriving on the board, a new user working on the document, and so on). The WAI group defined the Accessible Rich Internet Applications specification (WAI-ARIA) to make dynamic web content and applications more accessible to people with

disabilities [10]. Using WAI-ARIA, web designers can define roles to add semantic information to interface objects, mark regions of the page so users can move rapidly around the page via keyboard, define live regions, etc..

Interaction via screen reader

Blind people perceive page content aurally and sequentially when accessing the Web by screen reader and voice synthesizer. Furthermore, blind users navigate mainly via keyboard. This kind of interaction leads to several problems in perceiving content, as content serialization, lack of context, lack of interface overview (if the content is not organized in logical sections), mixing content and structure, difficulty understanding UI elements or working with form control elements (if not appropriately organized for interaction via keyboard), etc.

The Original Google Docs UI

Several difficulties are encountered when interacting with Google Docs via screen reader [6] including:

- inaccessibility of some interactive elements (not standard (X)HTML elements, with labels announced just as simple text)
- difficulty orienting oneself on the interface, with no possibility of quickly accessing its main functions (such as creating or accessing a document) or the document list
- lack of the summary attribute for table used for the document list, not allowing one to obtain useful information on its content
- the main menu (file, edit, view, etc.) and the style formatting toolbar (font type or size, etc.) of the editing page are inaccessible; bold, italic or underlined functions can be used only through shortcuts.

The Modified Google Docs UI

The modified interfaces maintain the same look&feel of the original ones (Fig. 1). The main goal is to make the same UIs more accessible and usable for all by preserving the same layout, showing how a UI can be made usable by everyone including who interacts via screen reader.

Fig. 1. Modified Google Docs UIs: (1) log-in, (2) list of documents, (3) a word processing document

All the elements of the modified UIs are standard (X)HTML interactive widgets (buttons, links, pull down menus, etc.) that now are focusable via Tab key and operable via keyboard, so accessible and correctly announced by the screen reader.

To solve the difficulty of orienting oneself on the interface, the modified UIs uses ARIA landmarks and hidden labels to provide a “logical structure of UI content”. Thus, using special screen reader commands,

the user can rapidly jump to a desired section of the page ("main", "search", or other standard/customized regions) to another. Specifically, hidden labels were used as a trick for associating labels with customizable UI sections, because at the moment browsers and screen readers are unable to correctly announce them.

In addition, to further simplify the user interaction, a summary attribute has been added to the document list table.

The editor has been substituted with a simplified but accessible editor (TinyMCE[1]) that allows one to correctly edit via keyboard and to access the toolbar.

These modifications allow a better navigation experience for blind users. In this demo we intend to show the interaction via screen reader and vocal synthesizer with the original and the modified GoogleDocs user interfaces.

Discussion and Future Work

At the moment, the prototype has reduced functions (vs Google Docs) and only allows interaction for document editing:(1) the log-in page, (2) the Google Docs personal home page – i.e., where all of the user's documents are listed – and (3) the Editor page for a document (word processing) which implements the main accessibility features considered in our approach. However, this prototype shows how interaction changes (and improves for blind users) comparing the original and the modified UIs. In the future we plan to extend the prototype, making collaborative features of Google Docs accessible via screen reader, and to carry out user testing with blind people to gather data on the proposed solution.

[1] http://tinymce.moxiecode.com/

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Collaboration in the Era of Ubiquitous Technology: Studying Socially Represented Embodiments

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Abstract. Our daily lives are increasingly mediated by ubiquitous technology. In my thesis I plan to present results from a number of case studies where people collaborate together with newly developed technologies such as public multi-touch displays, mobile augmented reality and social media. My aim is to observe and analyze from social psychological perspective how these novel technologies, designed to be intertwined in people's everyday lives, affect collaboration and can be studied in real-life settings.

Socially represented embodiments

Paul Dourish (2001) has used the concept of embodiment to describe how all things, including technology, are embedded in the world and how their reality depends on their situatedness. Studies of embodied interaction emphasise the idea that people have active representations embodied in the systems that they use – we are not interacting with a computer as such, but with our idea of the computer, which is obtained and inherited through social interaction and shared culture with other people. For e.g. depending on where an interactive display is installed, it may represent different affordances to its users, even if it offers the same features.

In social psychology, the theory of social representations introduced by Serge Moscovici (1981) has been used to explain how new things (for e.g. technology) are adopted as part of our everyday lives in communication with others through

the processes of anchoring (we anchor the information we receive about the new objects with the previous information we have of other similar objects) and objectification (abstract objects are understood often through comparisons to more concrete concepts, for e.g. European Union can be objectified to its flag).

Embodied interactions and social representations are manifested when people together try to learn how to operate a new piece of technology together. Also other factors affect the interaction and collaboration between participants, such as public nature of the environment, social roles, norms and the features of the technology in use, which make analyzing and understanding the technology mediated collaboration a challenging task. In CSCW and HCI embodied interaction and collaboration has been mainly studied in qualitative studies in controlled setting, where for e.g. collaboration on a technology-mediated task is video-recorded and then analysed in detail for e.g. see Luff et al. 2003). For detailed analysis of bodily movements and collaborative interaction a controlled experiment is a valid choice, but for gaining more understanding on how the mixture of embodied interactions and social representations—that I call "socially represented embodiments"—are affected by the real-life physical and social environment while people are learning how to use ubiquitous technology collaboratively, we need to step out from the laboratory.

The key research problem that I aim to address in my thesis is to show how collaboration with different ubiquitous technologies can be studied in real-life settings by using a multi-method approach and by defining the concept of "socially represented embodiment" and using it as the theoretical framework for interpreting the results of six case studies.

My contribution and research activities

The theoretical contribution of my thesis is in presenting example cases how two different approaches to understand collaboration and technology, the concept of embodied interaction and the theory of social representations, can be integrated as the concept of "socially represented embodiment", to provide insight on how people learn to use new ubiquitous technologies together. In this light I intend to analyze multiple episodes of technology assisted and mediated collaboration with public multi-touch screens, mobile augmented reality (AR) and social media applications such as Facebook and learning environments like Moodle.

Through organizing field studies and collecting data in various formats I also hope to contribute to the methodological discussion of how to evaluate collaborative ubiquitous technologies in different contexts and development stages. In studies I have participated in conducting and publishing so far (Peltonen et al., 2007; Peltonen et al. 2008; Morrison et al., 2009) we have presented cases how to collect and analyze data from multi-touch display installed for several months in public space and used by thousands of people in contrast to pervasive

game that was used to evaluate collaboration with a still unstable mobile AR prototype.

My current research focus is in social media and learning environments: I have collected data from multiple cases where groups of people have used different Internet-based technologies for collaboration the first time. I am still analysing the data and these studies are still unpublished. I have also contributed to the discussion on generational use of new media by co-authoring a book chapter (to be published in 2012), where we discuss the situation of digital natives and digital immigrants based on our observations from a "communication summer camp" held annually in Finland.

Expectations for the colloquium

For my thesis I have collected all the data I need and have succeeded in publishing four (out of six needed) case studies so far: three in conference proceedings and one in a book chapter. The case studies I plan to include in my thesis have been conducted in various research projects in different institutions. What they have in common is that they are a) qualitative studies conducted in real-life settings and b) they describe how people use novel ubiquitous technologies in collaboration.

I would appreciate the feedback from the colloquium on the following topics:

- Do you find my research problem I have described earlier interesting and/or novel enough?
- Is the theoretical contribution I have presented enough for a PhD – and if not, do you have ideas how to strengthen it?
- The methodological discussion on controlled laboratory experiments vs. real-life studies "in the wild" is not a new one and in CSCW one can find a long history of ethnographic and naturalistic workplace studies (for e.g. see Hughes et al. 1994). My view on the subject is based on observations how collaborative ubiquitous technology—that is many times designed for public use—can be studied to understand "socially represented embodiments" by using a combination of ethnographic observations, psychometric tests and interviews. Do you find this view interesting and novel enough?
- I have labeled technologies that seamlessly integrate in our everyday lives and environment as ubiquitous technology: multi-touch screens, mobile phones and social media. These technologies are maybe not exactly as "invisible" as what Weiser (1991) means with ubiquitous computing. Do you think my definition still can be used or should I think of something else?

Acknowledgments

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Pilot implementations and learning in CSCW settings

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Abstract. Pilot implementations of new technology in organizations have been proposed as a promising approach to uncover emergent knowledge and learning of the specific work practices in which they are implemented. In this research proposal I will discuss how a participatory approach to evaluating CSCW applications may support mutual learning.

Research context

My Ph.d.-project is a collaboration with the public healthcare sector in two Danish regions: Region Zealand and Region South Denmark. The project is to evaluate a pilot implementation in which 17 ambulances in the Region of Zealand will be equipped with electronic ambulance records (EAR), testing the transition from paper to computers over the course of 6 months. A Norwegian vendor will supply the software and hardware necessary (a touchscreen-based tablet).

The EAR will attempt to both support situated work and situation awareness in the ambulance as well as activity awareness of the ambulance work at the ED. However, the first step of the implementation will seek to support the ambulance crew in documenting the patients. The second step is to integrate this information with electronic whiteboards at the emergency department (ED). The IT artifact has an important strategic perspective: closing the minor emergency departments in the regions, removing physicians from the ambulances and replacing them with paramedics. The ED personnel wants the EAR to continously supply measurements

of vital parameters about incoming patients to their electronic whiteboards. The ambulance crew wants to ensure that the clinical observations they produce as part of the ambulance records are also used by ED personnel.

The political goal overall is to support information sharing and use of patient documentation throughout the patient trajectory from ambulance pickup to discharge from the hospital, thus reinforcing the transition from prehospital to hospital care.

In my involved research group, an evaluation framework called "Effects-driven IT development" (EDIT) is currently being developed and tested. EDIT is an evaluation method for systematically and iteratively evaluating desired effects of the new work system constituted by implementing new technology, preferably as part of a *pilot implementation* (Hertzum and Simonsen, 2011). These effects are specified and evaluated using participatory techniques, involving the participants whose work practices will be affected by the new technology. Pilot implementations have been proposed as a promising approach to mutual learning about how the IT artifact is used in real working settings (Bansler and Havn, 2009). Mutual learning is a participatory design concept denoting the learning that occurs when designers and practitioners engage in shared activities towards a common goal (Bø dker et al., 2004). However, very little literature exists on what kinds of learning and knowledge emerge and how to go about conveying this in real work settings. In my project, I will experiment with the EDIT framework in a pilot implementation setting to better understand this somewhat intangible concept of learning.

Hence, my working research question is: *"What kinds of mutual learning occur in participatory evaluations of pilot implementations?"*

Previous work on evaluations in CSCW settings

Evaluations of CSCW-applications are scarce in the research literature (Plowman and Rogers, 1995) and ridden with obstacles (Neale et al., 2004) for a number of reasons. For example, it can be very difficult to assess or measure who will actually reap the benefit of the work performed as well as define those benefits during use. Several methodological attempts have been made: using situated and informal interviews to assess evaluation (Twidale et al., 1994), as well as arguing for mixing both qualitative and quantitative methods to assess communication needs (Neale et al., 2004).

For groupware that support long-term cooperative activities, Neale et al. (2004) present three major obstacles: (1) difficulty in coordinating logistics of data collection as the use of the CSCW application often is done synchronously between groups; (2) there are many contextual variables to consider, both on an individual usability level, social group level, and on an organizational level; (3) work practices change when new technology is used and there is a need for validating the newly re-engineered work as it changes (Neale et al., 2004).

Clearly the EAR-project stands before the challenges presented by Neale et al.

(2004). Although impossible to solve completely, I will try to discuss how to minimize their effect on the project in the following.

1. **Problem: complexity of logistics of data collection.**

   The complexity of evaluating a CSCW application in an ambulance is large because it is a mobile setting, further complicating where to gather data from and how to gather data in the communication situations between ambulance crew and ED. To minimize this problem, I will be taking a mixed method approach, mixing both quantitative and qualitative methods. Quantitative surveys in the ambulances will be filled out by the ambulance crew after each patient hand over, and analysis of usage logs of the IT artifact will be used to get representative knowledge about satisfaction, performance and "how" it is used. Data about the specific use, communication and information sharing and activities of ambulance crew and ED personnel is much more complex, though. To understand "why" the IT artifacts is used, observations following the ambulance crew and the patient all the way to the ED will be performed, focusing on the use of the EAR and how it changes hands. Observations and informal in-situ interviews at the ED will also be performed.

2. **Problem: many variables on individual, social and organizational levels.**

   Taking a participatory design-approach to data collection, the project will involve stakeholders on a political level to the ambulance crew and ED personnel whose work practices are influenced by the technology, ensuring that all stakeholders may influence the focus of the ongoing evaluation activities from start to finish. An ongoing dialogue may ensure that the variables and events on individual, social and organizational levels are discussed and prioritized as the project moves on, thereby reducing the amount of variables to take into consideration.

3. **Problem: the need for testing in a real work setting:**

   Focusing data collection on the re-engineering aspect of work practices will contribute to the overall research question: "What kinds of mutual learning occur in participatory evaluations of pilot implementations??" As the project is based on the structure of a pilot implementation, only real-life usage of the new technology will be evaluated. This may assure validity towards getting "real" results as opposed to results from a controlled laboratory setting. A force of the specific setting is that only 17 ambulances in the region will be equipped with the EAR technology, enabling a possibility for comparison between work systems with and without the technology.

Research design and originality of work

The overall research design is based on action research with cyclical interventions playing a central part (McKay and Marshall, 2001). Interventions in this project

will take the form of workshops, questionnaires evaluating the CSCW application, and formative feedback of evaluation results to the participants through interviews, hopefully ensuring participants' focus on mutual learning and the effects that occur as a result.

The pool of empirical activities consists of the following:

- Observations of work before and after implementation of EAR.
- System logs: data with time stamp and system usage will be analysed and compared to each other.
- Survey data: A questionnaire pops up on the screen of the EAR after each ambulance run when a patient has been handed over.
- Experience-gathering semi-structured interviews: The semi-structured interviews will gather qualitative data about attitudes towards the system.
- Workshop with stakeholders present (ambulance crew, ED personnel and management) as fellow evaluators of the desired effects.

My contributions to this project will be to the existing discussion of how to evaluate CSCW applications, taking an effects-driven participatory approach. As my research question is centered around learning, I will also contribute to exploring mutual learning in real-life evaluations of pilot implementations.

I would like feedback on the following: a) The rigor of the research design of the project, b) The relevance of the project (how do you see interesting aspects of CSCW in this?), c) How my focus and research question can be even sharper, d) What could help my empirical activities.

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Plans at the workplace: planning the use of the apron in an Italian airport

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Abstract. Based on empirical material, this paper presents research which focuses on the character of plans in the apron tower, the coordination centre where the use of the apron of an Italian airport is planned daily. The preliminary data at our disposal shows that planning the apron activity is a situated, technologically mediated, socially distributed and time-constrained activity. As a consequence, we assume that this short-term, time-constrained planning activity, which has to ensure a balance between change and accountability, shows work features which are shared with en route and other forms of controlling work, but also features that make it unique. Our research, which will contribute to a body of literature on controlling work, could be of interest from a methodological point of view too, as our intention is to show how structures in the environment, interactions evolving over time, and talk and non-talk activities affect communication as it plays a central role in plan-building and revision.

Key words: articulation work, plans, talk-in-interaction

Introduction

The debate on plans in the CSCW community was opened by Suchman's work on plans and situated actions (1987). In fact she showed that cognitive models cannot

determine human actions, and that the interaction between subjects and plans cannot be understood as the mere deciphering of others' plans in situated actions.

> What traditional behavioural sciences take to be cognitive phenomena have an essential relationship to a publicly available, collaboratively organized world of artefacts and actions (1987 p. 50). There are no logical formulae for recognizing the intent of some behaviours independent of context (1987 p. 64)

Despite the relevance of this seminal work, several research in the CSCW community (see Schmidt 1999) argue that Suchman's work has mistakenly introduced a contrast between the plan as a representation of situated actions and actions as *ad hoc* improvisations. In fact, plans, from her point of view, may be considered resources for work rather than instruments that determine work activities in any strong sense. This way, an increasing theoretical interest in situated activities has led to the analysis of plans as 'guidance for work' and away from the study of how protocols, checklists, and programs might determine the coordination of work in organizations. Nevertheless, several studies in the last twenty years in the CSCW community (Button, Sharrock, 1994; Bardram, 1997; Schmidt, 1999, 2011; Dant, Francis, 1998; Koskinen, 2000; Rönkkö *et al*., 2005; Harper *et al*., 2000; Randall, Rouncefield, 2007) have shown that the false dichotomy between plans and situated actions can be removed. Bardram, for example, suggests that it is possible to talk about *situated planning* (Bardram, 1997) as plans themselves are implemented *in situ* in that they are made out of situated actions. Rönkkö *et al*. (2005), on the other hand, have highlighted that 'plans "necessarily" underdetermine situated actions' because 'no rule dictates its own application' (p. 436). So their research focused on the importance of plans even when they do not work out and re-planning is necessary.

Our aim is to contribute to this discussion on plans in CSCW with the analysis on how the use of the 'apron' in an Italian airport is planned. The research is still at a relatively early stage and has so far involved the collection of data over a period of two months. The originality of our work resides both in the description of a coordination centre which carries out a particular activity not yet fully described in the area of CSCW studies (but see Goodwin and Goodwin, 1996). As stated above, the work will contribute to a body of studies on controlling work, with the aim of generating a stable set of features which can be used for comparative purposes in and through analysis of the kind detailed below.

The apron is a well-defined area next to the runway where aircrafts are parked and where handling activities take place. The planning activity necessary in order to ensure the efficient use of the apron is carried out by the personnel employed in the apron tower, which may be described as a communication centre for the coordination (Suchman, 1997) of the activities that take place on the apron. This means that the main activity of the personnel employed in the apron tower is to assign a parking area to each aircraft on the ground and to coordinate the handling activities, such as fuelling, cleaning, boarding and disembarkation activities that are requested for each vehicle. So, in order to successfully handle each aircraft, the apron personnel have to:

- plan in advance where to park each vehicle (considering, among others things, the aircraft's size, the manoeuvres necessary in order to move the aircraft out of the parking area, the typology of each flight – charter or freighter – and, passengers' safety and security);
- be able to detect in advance if the solutions planned earlier are still useful despite, for example, a flight delay;
- correct the plan if necessary.

Research description

Our case study (Stake, 1995) aims to understand the particularity and complexity of the planning activity carried out by the personnel of the control room which coordinates the handling activities that take place on the apron of an Italian airport. It uses ethnographic methods (Randall *et al*., 2007) and analytic procedures to describe and analyse the work of controllers at work 'on the apron'. It will draw, more specifically on a number of interrelated themes:

1. Planning. In order to understand how this controlling work is both 'planful' and at the same time constantly oriented to contingency, we will draw on some of the more sophisticated developments from Suchman's original work (see above). First of all, the personnel of the apron tower is directly involved in planning-in-advance – organizing schedules which are intended to describe the unfolding pattern of work – but also, and of necessity, engaged in constant updating or 'planning-on-the-hoof' in order to manage the contingencies that arise. The operators, in this sense, are the plan builders and the plan executors simultaneously. In addition, the plan is distributed. It is completed by different operators, who have access to the necessary information at different times of the day and using different ICT. This implies that the plan is the result of 'layers of decisions' made by several actors. Last, but not least, the plan evolves thanks to decisions made in due time, and operators have to make decisions and to produce consensus on the direction of the plan's evolution while managing several activities (on collective decision making see: Piccini, Carassa; to appear).
2. Talk-in-interaction. As has been pointed out in other contexts, 'awareness of work' is occasioned. The particular situation described above – a short-term, time-constrained planning activity which has to ensure a balance between change and accountability – affects operators' planning activity and, in particular, the communicative strategies used to interpret the plan, to detect deviations from it, and to make decisions about the necessity, or otherwise, of modifying it.
3. Materiality. Again, commentators from a number of theoretical perspectives (Schmidt 1999; Nardi 1996; Kaptilinen, 1996) have pointed out that talk-in-action is necessarily mediated by material artefacts that can both constrain and afford certain kinds of action. In this context, the artefacts that most directly affect the work are communication technologies (radio,

telephones, email, a telex network) and IT (different representations of the apron and an electronic representation of the strip rack).

4. Sequentiality. Drawing on insights from ethnomethodology, ethnographic work in CSCW has paid close attention to the sequential organization of activities in order to illustrate and explicate what the 'member's problem' looks like (Garfinkel, 1967). I will show in this study that time criticality is a central feature of the controller's problem, no less than in en route controlling activities, and that this feature strongly influences scheduling activities.
5. Knowledge work. As Randall *et al.*, 2007, have pointed out, one feature of skilful work has to do with what it takes to be 'good' at it. The paper describes some of the knowledge and skills that are routinely deployed in order for competent work to be done. These include, for example, the knowledge of the distance among parking areas and gates. The knowledge of the airport spaces organization, in fact, is relevant as it affects the planning of the passengers' boarding in order to respect the boarding time agreed between the handler and the airline companies.

The research contributes to the existing literature on control rooms, and ultimately to a body of work on controlling work that might allow us to understand both what the general and more specific elements of controlling work look like. We will argue that there are features of work 'on the apron' which are shared with en route and other forms of controlling work but also features that make it unique. Moreover our research could be of interest from a methodological point of view, as our intention is to show how structures in the environment, interactions evolving over time, and talk and non-talk activities affect communication, as it plays a central role in plan building and revising. Last, but not least, the study is of interest because it is closely connected with safety in airports.

This research follows a previous research project on the control room of an emergency medical service (Dovigo, Redaelli, 2010) in that we are particularly interested in analyzing cognition at work as a situated, distributed and mediated activity, and in understanding how time constraints affect strategies of decision-making, problem analysis and problem-solving.

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Representing Deixis in Collaboration

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Abstract. Geographical Information Systems (GIS) have recently embraced CSCW techniques to support collaborative work involving maps. However, mixed-presence or remote collaborations provide only limited bandwidth for communication. Deictic gestures, commonly pointing gestures, comprise one portion of the missing communication bandwidth, yet existing solutions are limited in conveying the information they contain. My research has identified the most common deictic gestures in geocollaboration, designed and evaluated embodiments capable of expressing the salient features of those gestures, and developed a toolkit for supporting the use of the Microsoft Kinect as a non-intrusive sensor for over-the-table gestures. I have also performed an extensive exploration of the design space for surface-based user embodiments, including proof-of-concept implementations of several of the designs. Finally, I am exploring a method of encoding gesture data as meta-data within the GIS as a method of providing visualizations designed to answer *post hoc* questions asked by temporally remote participants about events during collaborations.

Introduction

Geographical Information Systems assist in a variety of collaborative processes involving space-related problems. As the technology has matured, many people need tools associated with GIS that support geographically and temporally remote collaboration. Previous work in many domains has identified gestures, and especially deixis (e.g., pointing), as an important component of communication in collaborative environments (e.g. [1]). However, with only a few exceptions, most collaborative tools for large-screen and tabletop interaction fail to support natural deictic gestures for remote participants.

My doctoral research addresses the problem of representing deictic communication in GIS when collaborators are separated by time or space. My research is in four main parts:

First, I identified and classified the most common deictic gestures used during collaborative GIS-based decision-making by qualitatively analyzing field observations. Second, I designed and implemented a set of visualizations that convey the salient aspects of the most frequently used gestures I have observed. In particular, my designs include a representation of the gesture's height above the table -- an aspect ignored in most cursor-based collaborative visualizations. I evaluated these designs along three axes:

1. the accuracy of gesture and target identification;
2. whether or not the height component of the visualization is interpreted in the same way as the height of a gesture is interpreted in collocated collaboration;
3. and how people use embodiments that include a representation of gesture height.

Third, I performed a general analysis of embodiment design space and implemented a variety of embodiment techniques using the Microsoft Kinect as a primary sensor. This analysis is accompanied by several proof-of-concept designs and brief evaluations. Finally, I will develop and evaluate visualizations for use in asynchronous collaborative environments that support the aggregation of gestural data (for highlighting areas of interest on the map) and the disambiguation of deictic references made verbally.

Work in Progress

I have observed, both in the laboratory and in the field, collaborative interactions over maps and documented the gestures made during these collaborations. From these observations, I have classified gestures over surfaces, and in particular over maps, along four axes:

1. The *morphology* of the gesture, or what parts of the body are used, and how, during the gesture.
2. The *atomic* components of the gesture, or what small, indivisible actions are performed during the gesture.
3. Where the gesture occurs above the space of the table, or the *height* of the gesture.
4. The set of additional physical characteristics of the gesture, such as pressure applied to the surface, wiggles, or idiosyncratic *variations* in the execution of the gesture.

User embodiments are a common solution to user representation in distributed collaboration and can take many forms, from abstract representations of the user's

behaviour [2] or characteristics [4] to highly realistic embodiments [3]. However, neither realistic nor abstract embodiments are effective in representing the richness of deixis exposed through my classification (see Table 1).

Component of Deictic Gesture	Abstract Embodiments	Realistic Embodiments
Show differences between similar atoms	No	Possible
Represent stroke atoms	Yes	No
Express one or two finger pointing	Yes	Yes
Express full range of possible morphology	No	Possible
Represent height	Possible	No
Represent wiggle variation	Possible	Yes
Represent pressure variation	Possible	No
Represent width variation	Yes	Yes

Table 1. Gesture visualization capabilities of embodiments

In between realistic and abstract embodiments, lies the possibility of hybrid embodiments that incorporate the advantages of both realistic and abstract embodiments, an approach pioneered in the work [6] on extending Videoarms [5].

My work continues this exploration with the development of a set of embodiments capable of expressing the height of a gesture with the intention of combining them with video-based, realistic embodiments. Through user studies, I found that gesture-enhanced embodiments improve the accuracy of gesture and target identification. People also ascribe the same aspects of communication to height representations that they do to height in collocated gestural communication. In particular, people interpret gestures that are close to the surface of the table as more specific, confident, and emphatic than gestures that are higher above the table. Finally, I observed how people behave when given traditional telepointers and my new designs. In general, users adapted quickly to the enhanced telepointer, pointed more naturally after their adaption, and began incorporating new methods of pointing as they discovered the potential for identifying out-of-reach targets and emphasizing paths on the surface of the table.

The two final portions of my work are ongoing: I am developing a toolkit for using the Microsoft Kinect as an over-the-table sensor capable of detecting the 3-dimensional location of a gesture. I intend on using the toolkit to rapidly develop a series of proof-of-concept designs as part of a larger exploration of the available design space for tabletop embodiments. The final portion of my research will explore visualizations that support temporal distribution, permitting the *post hoc* review of collaborations and allowing analysts to ask more sophisticated questions about GIS-based interactions.

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Interaction Design Perspectives on Applied Health Technology

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Abstract. The transformation of the healthcare sector, in terms of being more efficient and accessible for individuals, will change the way we design and develop supportive products. In this paper I argue the relevance of using interaction design (ID) perspectives on applied health technology and having a need-driven approach in development where healthcare staff are closely involved. I also reflect upon the fact that individuals such as patients or relatives will be stakeholders and users as well, as part of the *Computer Supported Cooperative Work* (CSCW), and how this will affect the design and development for healthcare products.

Introduction

Even though there are several benefits in using e-health[1], still many products (including services) that are currently used in healthcare do not work satisfactory and are considered time consuming and illogical[2]. This could also have a negative impact on quality of service (QoS) in teamwork environments of patient care (Weerakkody et al, 2003). One reason could be that healthcare is among the most complex and highly collaborative domains of work practice in the world (Reddy et al, 2010) and that it has become more complex in terms of its use of different ICT products. It can be assumed that one reason for this situation is that the development process has been inadequate. In Sweden only 29% of the healthcare staff is satisfied with their user participation in the development process and many are suffering from stress and tension caused by the malfunctioning of IT systems[3]. Added to this is the extension of the actual user, from being a healthcare employee and work-oriented user, to also include patients and relatives. In other words, there is a lot of work left to be done before IT fully can support the healthcare sector in its goal to be more efficient and accessible.

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1 http://ec.europa.eu/information_society/activities/health/index_en.htm

2 http://www.usersaward.se/home/ua/home.nsf/unidView/EE169726CCE2B1F0C12577CE0038EE3E/$file/Vård-IT-rapporten.pdf

3 http://www.usersaward.se/home/ua/home.nsf/unidView/EE169726CCE2B1F0C12577CE0038EE3E/$file/Vård-IT-rapporten.pdf

Research problem

I have worked for several years as an interaction designer and project leader in the area of e-health, in research and development projects with collaboration between academia, municipalities, county councils and companies. In one e-health project[4] the purpose was to increase the user involvement and the understanding of both the context, the explicit and implicit needs that people have, to be able to better support them with ICT. We used the methodology *Needfinding* (Patnaik et al, 1999) as a starting point when creating the concept of a *needfinder* (Bergstrom et al, 2006) as an important role to succeed in a need-driven process (Ericson et al, 2007). The task of a *needfinder* is to find the needs and the problem area and then mediate it to the rest of the development team by using qualitative and creative methods. As an interaction designer I became the *needfinder* in our project working on understanding the problem space, the context and the user needs.

In my research I focus on the mechanism/role of understanding, interpreting and mediating people's needs connected to a certain context, in order to develop a supportive technical product for healthcare. This includes both the work-practice for the caregivers as well as the settings for the caretakers. I'm especially interested in *who* will have this role during a development process and what skills, tools or methods this *role owner* need or use. I also want to study how the design and development will be affected when the role of the user or stakeholder changes. By doing this I wish to contribute to an understanding on how ID perspectives can improve the healthcare sector by using a need-driven approach in the development process.

A shift in stakeholders within healthcare

According to (Reddy et al, 2010) the healthcare domain is a key area to CSCW (Koch et al, 2006). Since the healthcare domain is changing towards being more accessible in terms of individual access of information it also may affect the work practice. The transformation we are facing when it comes to the way healthcare is provided or used give us other stakeholders (patients, relatives etc.) to take into account when developing technical artefacts (Gabrilli et al, 2010) It also raises new research questions about the collaboration among these different stakeholders and the role of the user. The change towards individuals managing their own health information through a *Personal Health Record (PHR)* raises new questions about collaboration mediated over differing levels of expertise and terminology, as well as across organizational boundaries and professional disciplines (Reddy et al, 2010)

4 http://www.designforwellbeing.org/?page_id=219

Interaction Design and Applied Health Technology

Applied health technology[5] is a new interdisciplinary science that includes studies of how health may be related directly or indirectly to the implementation and impact of technology. It concerns supporting management or development processes as well as studying how technology can improve the quality of life for one specific patient or group. Regardless of focus there will be people using the technology and people developing it and *someone* needs to combine these in order to make it work. As I see it ID could be the knowledge area where these *someone* could emerge.

ID is one domain that has a central concern in developing interactive products that are usable (Preece et al, 2002) Some are considering ID to be the knowledge on how to build user-friendly artefacts and systems in terms of interface, material, structure, colour and shape (Löwgren 2008) Others are referring to HCI and the knowledge of work practice when developing products (Carroll, 2002). Recently these two approaches have become more closely affiliated since the world and our daily lives are more influenced by technology (Löwgren, 2008).

According to my experience ID is so much more than just designing an interface, it involves the context in which the use occurs, including the physical environment, other users, products etc. and not the least, the interaction between these actors.[6]

Since the use of a single product is most likely connected to others, a holistic approach is preferred over a "drill hole approach" when it comes to development of products, to ensure interoperability. It is therefor important to have *someone* that can understand the holistic view and it's relevance to the design and development process. This is most certainly something that ID can contribute to by being a domain that understand the problem space and makes the implicit explicit (Preece at al, 2002)

The research problem and the doctoral colloquium

First of all I would find it supportive to get feedback from others point-of-view on the research problem addressed in this abstract since my experience in CSCW and e-health is mostly Swedish and practice oriented. Second of all I hope the doctoral colloquium will give me access to a useful and competent network of people, with different backgrounds, for a mutual benefit of knowledge and experience sharing.

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5 http://www.bth.se/hal/applied_health_technology.nsf/

6 http://www.use-design.com/eng/design/interaction_design.php

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Mobile and location-based computing in cars

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Abstract

Advances in technology are causing a change in the way computational systems are designed. These computational systems are continuously embedded into the everyday activities people undertake in society and improving on their design is a major interest for CSCW. The use of in-car navigation systems for planning and making unfamiliar journeys is a growing trend and these devices are continuously redesigned to offer users better services. This paper looks at research done that investigates the navigation situation which sat nav and paper maps support and identifies issues which exist with their use. Field studies were conducted in order to identify senses of location and situated practices displayed by drivers during different journeys to inform the design of a Head-Up Display for navigation that can be embedded in a natural interface in cars. It presents the concept of a virtual car prototype being designed which integrates situated practices of way-finding in its display and will be projected on the windscreen of the car for drivers to use during unfamiliar journeys. The similarities and differences of the virtual car prototype with other in-car navigation systems in the field studies will be examined to highlight benefits to users.

Keywords: Situated practices, in-car navigation systems, way-finding, virtual car

Introduction

This paper presents work done in the field of developing mobile and location-based computing systems in cars for unfamiliar journeys. It highlights unfamiliar journey making with car drivers as a single instance of collaborative activity where computational systems used can be improved upon by highlighting issues that currently exist with their use. It talks about way-finding as a collaborative activity which drivers undertake on the road with other road users and in-car navigation systems aim to support this activity during unfamiliar journeys. However, such navigation systems can also cause drivers to be distracted and disengaged from this collaborative activity they are meant to undertake where they have to intermittently shift attention from the vision of the road to a small display which is not in their line of sight based on its design and nature of navigation instructions the drivers have to work with during unfamiliar journeys. These distractions and disengagements occur because most visual interfaces used in cars for planning and making unfamiliar journeys require that the eyes of the driver are taken off the road and manual controls require the hands of the driver are taken off the steering wheel [1] and such actions have a negative impact on performance and possible car crash [3]. However, while having to maintain concentration on the road, the drivers also have to pay attention to the instructions provided by the navigation system and translate their location from what is indicated on the interface of the navigation system to what is available in the real world around them which can often pose problems when undertaking unfamiliar journeys.

Design problem

A design problem was identified which highlights in-car navigation systems often causing distraction and disengagement from the vision of the road for drivers as situated practices of driving and way-finding are not well integrated in their design for use during unfamiliar journeys.

Field studies

There were three field studies conducted with car drivers to find out how they did way-finding by identifying the senses of location and situated practices the drivers displayed during their respective journeys to address the design problem. The first study was done with a driver who projected and recalled information from his memory to plan and make a familiar journey on a familiar route between Wollaton and Ilkeston Shipley Country Park. The second study was done with a driver who used a paper map to plan and make an unfamiliar journey on an unfamiliar route between Nottingham city center and Burntstump. The third study was done with a driver who used a sat nav to plan and make an unfamiliar journey on an unfamiliar route between Wollaton and Sandiacre. The key findings are presented from the analysis of the data.

First study Second study Third study

Figure 1: Snapshots from field studies

Key findings

There were a range of subtle and nuanced situated practices of way-finding that were tied to particular locations and senses of location which were identified from the studies. These include; first of all, that the '*embodied actions*' [8] displayed by the drivers were situated at various places on the road such as junctions, roundabouts, traffic lights etc. For example, when the drivers approached a junction and intended to turn left, they turned on their indicator to signal to the left, looked into their rear and side mirrors, slowed down, stopped where necessary and watched traffic to spot gaps which they could fill to join the road that led them on. These things were all done to accomplish actions at specific locations while undertaking a journey and not doing them has certain consequences. For example, drivers failing to look into their side mirrors when a motorcycle is riding along the side they intend to turn into can lead to an accident.

Secondly, the actions of the drivers on the road were recognisable by one another which allowed them to collaborate and mutually organise their activities. In essence, they were '*mutually accountable*' [5] to each other for the actions they carried out on the road. For example, when approaching a roundabout, drivers attempting to enter the roundabout had to give way to traffic on

the right because without doing so, they could run into an oncoming vehicle. If a driver was driving on a roundabout and spotted other drivers wanting to enter it, the driver knew that he or she had the right of way and carried on driving while the other drivers had to wait until they could spot gaps on the roundabout to fill and carry on. These actions were accomplished through gaze, gestures, signalling and knowledge each driver had of what they were supposed to do at specific places. Thirdly, to "competent" drivers they made their actions ordinary during their respective journeys. Harvey Sacks describes doing '*being ordinary*' at something as "*spending time doing usual things with usual people in usual ways*" [9]. For example, in order to turn left at a T-junction, drivers have to slow down and gently turn left into the road that leads them on. Attempting to make a left turn at a high speed would cause them to lose control of the car and possibly crash into other cars on the road and so ordinarily knew they had to slow down to turn at T-junctions.

Design solution

The field studies were exploited to inform the design of a Head-Up Display for navigation that would be embedded in a natural interface which would reduce distraction and disengagement of the drivers from the road and integrate situated practices displayed during planning and making of journeys in its display. It was very important to understand that drivers should not get distracted and disengaged from the road in coming up with a design because it can affect their performance at vital stages during unfamiliar journeys. Thus, a design concept of a "virtual car" prototype which is a Head-Up Display (HUD) used for navigation is presented which reduces the problems of distraction and disengagement from the road commonly found in navigation systems such as sat nav and paper maps. The virtual car concept is based on the idea that one car that knows the way leads and the other that does not know the way follows. The virtual car image will be projected in the line of sight of the driver on the windscreen of the car so that the driver can have a better focus on the road while using the virtual car system. However, the virtual car image will be transparent to ensure that it does not obstruct the view of the road for the driver and will integrate several situated practices of driving and way-finding such as making turns, indicating, changing lanes etc.

Scenarios of situated practices of driving and way-finding during planning and making of journeys using the virtual car prototype will be studied in laboratory driving simulations with experienced drivers as participants. There will be data collected from the studies which will be used as feedback for the final design of the virtual car system. The data gathered from participants on their experience with the virtual car prototype will be compared with that of sat nav and paper maps to highlight similarities and differences in their design such as their interface, nature of navigation instructions and level of collaboration permitted for the driver with other road users. The design of the virtual car system is intended to open up a new range of possibilities for the design of natural interfaces for Head-Up navigation displays in cars which reduce distraction and disengagement from the road and which integrate situated practices of way-finding in their design. Another area this virtual car system when fully developed can potentially find good use is in the training of new drivers. With the situated practices of driving and way-finding such as making turns, indicating and lane positioning integrated into the design of the virtual car, driver trainers can find this a very useful tool to show their students what to do at specific locations on a journey.

Conclusion

As in-car navigation systems are increasingly used in vehicles for unfamiliar journeys, they need to be designed so they do not create a problem for drivers on the road. Distraction and disengagement are issues many in-car navigation systems cause due to the nature of instructions they give. HUDs ensure drivers keep their focus on the road, thus, having a better sense of what is going on around them. This research looks at ways of representing in better ways everyday collaborative tasks, in this case, navigating, in computational systems. The virtual car prototype also looks to evaluate Paul Dourish's concern in [4] which is '*how computational systems can be made sensitive and responsive to the settings they are used in?*' The virtual car image will display actions such as making turns and changing lanes on the road so that the drivers can see and respond. Finally, concepts of location which were useful for the design of the virtual car prototype were examined. Mobile and location-based systems express location in two ways; coordinate or landmark [7]. Location expressed using coordinates is a technical concept elucidated through the notion of space and is how computers work [2, 6] evident in sat nav with instructions such as "after 200 yards turn left". Location expressed using landmark is a social concept elucidated through the notion of place and is how humans understand location with instructions such as "turn left at the next junction into Davidson street". Designers need to properly integrate both concepts of location into the design of collaborative systems they design for way-finding to ensure such systems can achieve their full potential.

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Patient and Care Network can Improve Interoperability of Telemedicine

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Abstract. The Shared Medicine Card (SMC) is a national service in Denmark that allows citizens/patients and caregivers to access citizens' medicine information. SMC web service implements a national standard "The Good Web Service"(TGWS), intended for Danish healthcare. SMC is exposed as SOAP based web service, which allows client applications to securely exchange confidential medicine information with SMC. The project Net4Care supports an idea of a plug-and-play market for telemedicine by integrating existing stand-alone telemedical systems to national healthcare services. Telemedicine should be easy to install on citizens', patients' and caregivers' devices to support collaboration and better health quality and support business opportunities of telemedicine. However, it turns out that integration of telemedical systems that support patients/citizens needs, to national web services is not possible, because firstly, TGWS has not specified citizens interactions with their private health information. Secondly, if citizens will be able to access their own health information through telemedicine then the TGWS specification should consider a possibility of sharing confidential health information not only between care givers but also among a *care network:* spouse, next of kin, or a volunteer. An aim of this project is to design security policy for Danish telemedicine.

The vision of Net4Care and PhD thesis

Net4Care (NC, 2010) aims at lowering the implementation burden of telemedicine by stepwise integrating telemedical applications to existing health and welfare systems and extracting common integration components into open source libraries for reusability purposes.
My interests lie in identifying software engineering challenges, which can be faced by developers of telemedicine during integration to existing health and

welfare systems. My aim is then to ease the burden of developers, by creating new models, components, and libraries for reusability, which I call *materials* (as inspired from materials used by carpenters). If time permits I would like to create *tools* that would fasten the coding process of telemedical applications, leaving more budget for designing user-friendly interfaces that support collaborative care.

As a first step towards lowering the implementation burden of telemedicine we have conducted an experiment of integrating a telemedical application, called Remote Rehabilitation Support (RRS, 2009) to a national service Shared Medicine Card (SMC, v1.2.4). The experiment of integrating RRS to SMC is described in the next section.

Experiment of integrating RRS to SMC

Remote Rehabilitation Support is an application for a hip operated patient and his *care network* (Grönvall, 2010), which informs the patient before and after the operation on his medicine, X ray pictures of the hip, allows video conferencing and contains other educational material. It is an end-to-end system, where a patient via a client application can exchange information with a client application at the hospital, while shared information is placed on the server, located at university.

RRS server contains among other things the medicine information of the patient and when needed a nurse at the hospital uses RRS to change the medicine schema of the patient. The nurse would also change medicine schema in the patients Electronic Health Record (EHR). Instead of using a server to share medicine card, we wanted to integrate the RRS medicine schema directly in SMC, because it saves nurses time and SMC guarantee high availability.

The integration should be easy using XML based SOAP technology. The SMC web service requires a security header, which contains a signed identification card of the user. It turns out that the level of security SMC web service understands, which is 4, is described in a standard for web services of Danish health care systems, known as “Den Gode Web Service”, or The Good Web Service (TGWS, v1.0). Level 4 security (see section below), is a decision which developers behind SMC have made built on top of TGWS. This standard might be a source of telemedicine interoperability problems and the analysis of it, together with conflicting political IT- strategies for Danish health care follow below.

Citizen Dilemma of Web Service Standard

Historically the national IT strategy for Danish Health Care evolved from a strategy that supports clinicians and care givers with electronic patient records (EPR), to a strategy that supports citizens and patients, with digitalized treatment and health services. (Rasmussen et al, 2008) Latest national IT strategies emphasized the need of enabling citizens’ participation in their own personal

care[1]. However, TGWS standard, by MedCom (medcom.dk), does not even mention citizens' interactions, with web services of Danish health care. The standard, excludes the citizens with its security policy[2] or precisely, its five security levels described below:

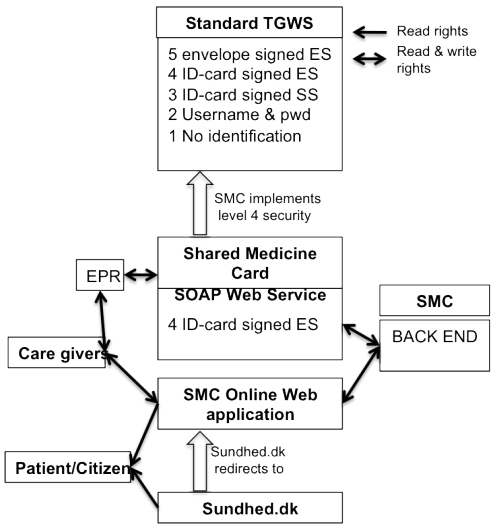

Fig 1. National web service standard, TGWS, does not specify citizens interactions and authentications. This leads to SMC service, which is only designed to support healthcare employees. Citizens must use web client directly or redirect to it in a web-frame.

5: Envelope is signed with employee signature (ES)

4: ID-card signed with employee signature

3: ID-card signed with system sig. (SS)

2: Username and password authentication

1: No personal identification

Security policy has a non-repudiation requirement, which means that at any given time it should be possible to prove that a user or a system has accessed the data.

Recall, SMC web service asks for a level 4 security from a service consumer, which stands for an employee signature. Meaning only employees can access SMC web service, while citizens cannot use their OCES signature or NemID card.

In the media and brochures about SMC it is stated that citizens can also access the medicine card and indeed they can do it via a specially developed web client at fmk-online.dk or sundhed.dk (a national web portal for healthcare). Developers behind SMC explain, that the way sundhed.dk allows citizens to view their medicine information is by redirecting to fmk-online.dk in a web-frame. This means that when accessing medicine information being a citizen, the data cannot be further processed and hence there is no way of integrating telemedicine to the national service.

Lowering Implementation Burden of Telemedicine

Current situation of the national web service is not satisfactory, as it does not cover citizens' needs for accessing their own private data. A web client solution of SMC that allows citizens view data cannot satisfy needs of telemedical

[1] Citation from National Strategy for Digitalization of the Danish Healthcare Service 2008-2012: "The individual citizen and patient should have better opportunities to take care of his or her own health. The strategy comprises the entire healthcare service and all efforts to promote public health, as well as prevention and treatment – including tasks performed by the individual citizen/patient."

[2] Security policy consist of authentication, authorization, confidentiality, integrity and non-repudiation properties (later proof that users accessed data). Confidentiality and integrity guaranteed by VPN/SSL

applications that should support and improve healthcare service, because it should be possible to pass the data to e.g., patients calendar application, which would remind him to drink the medicine in time. The idea of a national web service is good, but standards should explicitly state that citizens must be able to authenticate as well.

We have conducted a quality attribute workshop with the developers (ethnographer, clinician and developer) of RRS and the main input that we got was a requirement of RRS that allows supporting group of the hip operated patient to work with the system on behalf of the patient. This means that it is not enough to simply allow a patient/citizen to login to the system, because in RRS and in other care systems, it is usually the spouse, next of kin or other person from a care network that should perform care and thus interact with telemedical applications. Thus access of health information on behalf of a person from care network should also be supported by a security policy for telemedicine.

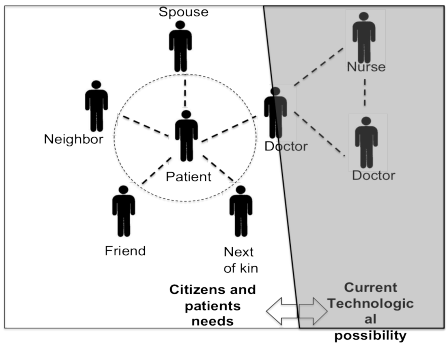

Fig. 2: Circle around the patient is his care network. Current standard supports only collaboration of the grey area, or caregivers. New standard should support patients needs, expressed as collaboration in care network.

I believe that in order to ease implementation burden of telemedicine there should be designed a security policy or standard for telemedical applications that support citizens' needs.

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