

Virtual Reality for Augmented Collaboration and Accelerated Learning among Process Plant Workers

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Abstract. When talking about learning at work, especially in industrial setup such as that of the Process Plant works, it is very crucial and important to note that most of the knowledge shared is tacit experiences of the competent worker, which he has to impart to the newcomer. This research work was focused on how to enhance this important aspect of social interaction. The research was initiated as a thesis dissertation of the author.

1 Introduction

The aim of this paper is to present how the empirical knowledge and observations of the author during the study of three process plants in Denmark namely: Tuborg-Fredericia, Sønderborg Wastewater Treatment Plant and Danfoss-Nordborg's Electroplating Waste Control Plant, between November 2003 and April 2004 was transformed into design concepts through extensive use of video documentation which were later analyzed for design conceptualization.

The project was commenced with ethnographic field surveys, interviews and workshops at the process plants, with the aim of finding an opportunity for situated intervention.

The basic research questions, for the project were:

1. *How can Pervasive Computing technologies be employed to enhance social interactions and other functions among process plant workers?*
2. *What is the best way to design, a functional, aesthetic and ergonomic artifact that will fit seamlessly into the work-context of process plant workers?*

The project revealed to us that the day-to-day running of the Process Plants and relative ones is directly dependent on the alarm messages, documented logs of routine as well as special or uncommon alarms; and that the record of these alarms (Log records), were used to predict and hence plan ahead how to run of the plants.

The approach for executing the project was of two basic directions:

1. Concurrent ethnographic fieldworks [5], observations and interviews.
2. Participatory Design, which entails co-authoring of the emerging artifact through workshops and iterative [4; 2] refining of concepts by returning to the users.

1.2 Visualization as a way of effective communication

According to Davies: “A design method based around participatory design through visualisation and active involvement has previously been formulated and shown to be effective in a number of workplace design cases (Ehn et al.,1996; Wilson, 1999). The crux of this method centres on envisionment – using visual and experimental media to find a common language for a design team participating in the design of a work place. [Davies, 2004] This supports the fact that visual objects such as mock-ups, sketches, video cards, cultural probes, etc enhances dialogue [8] between all the stakeholders [2] in a design process.

1.3 Learning at work

The newcomer has to learn by doing, “It is follow the leader system here.” Poul, an experienced electrician at the wastewater plant, commented. They also said that the newcomer is gradually “charged” until he can start to do things by himself and that he would thereafter be ringing “home” if he is faced with a difficult situation.

The set goal of the project was how to enhance social interactions through tangible interface among process plant workers. How they communicate with each other and also perform their computer aided tasks daily, and how they build also their competence through collaboration and learning from one another [7].

1.4 Trying on the User’s shoe

As a way out of the design dilemma, it was suggested that the data from the fieldworks be presented to professionals (designers) for a collaborative analysis and hence prescription of design concepts as remedy to the identified workshop involving a group design professionals at the Mads Clausen Institute for Product Innovation (Held on the 29th of March 2004).

The workshop was targeted at inviting the participants, who were all design practitioners into the world of the process plant workers; to experience how these people are compelled to hear through another person’s ear, see with another person’s eyes and feel through other’s hands, everyday, because instructions and feedbacks are channeled via mobile phones and documented logs. Short video clips of the field studies [1] was presented to all the participants, but none of the video was on the collaborative design workshops with the user, for fear of influencing their creativity later on when they would be required to deliver 3-D sketches of three possible user interfaces for the process plant workers. Prior to this, there had been workshops in

which the plant workers were told to visualize a blank, white box as their communication tool and so show or draw on it to relay its functionalities. These were not disclosed to the designers partaking in the workshop.

A brief reflection [8] session was held to evaluate shared meaning. This was followed by participants' comments, which revealed to me as the organizer that they had experienced something very close to what I observed with the real process plant workers. The session was a success for *immersing* the designers into the users' world.

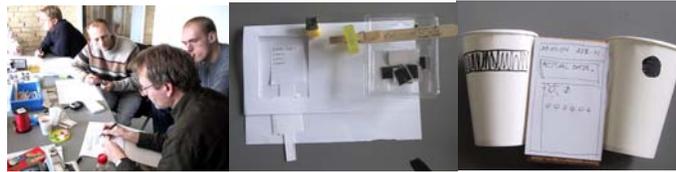


Figure 1. Tinkering session and two of the emerged early prototypes

1.5 Why involve the Users in the design process?

It is necessary to involve the potential users in the design of the artifact from the very beginning because “Complex design problems require more knowledge than any single person possesses because the knowledge relevant to a problem is usually distributed among stakeholders. Bringing different and often controversial points of view together to create a shared understanding among these stakeholders can lead to new insights, new ideas, and new artifacts.” [2] Inasmuch as the people expected to use the final product would do so in the context of their everyday work, it is quite logical to visit their work places, where all the action is taking place, [2; 4] for context-awareness for the emerging artifact.



Figure 2. Some of the white boxes used to provoke the user's creativity and facilitates dialogues that led to design concepts

2.1 Taking it a step further.

It was revealed after a new careful re-examination of the workshops, interviews and field works, especially the success of putting the camera in the worker's pocket, it became apparent that there was room for re-designing the interfaces and the interaction styles in a manner that will make the artifact to blend seamlessly, through RFID tagging, etc into the day-to-day activities of the user. This led to a new concept:

- Direct mounting of the device on the user's head is generated from the synthesis of all the desirable functionalities and also as a way to favor complete freedom of the hands, good positioning of the camera and the possibility of generating larger view of desired information as a superimposed holographic [11] images of similar repair exercise in the view of the worker as virtual guide for the task at hand as a form of “see and copy” concept.



Figure 3. Head-mounted concept for *Flashback* device, with its foldable visor, projecting networked Logs of the equipment's history like hologram in the view of the worker; the projected image can also be pictures or video footages of past repair activities by the experienced for situated, peripheral learning at the scene of the task a novice worker

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