Accessibility of Non-verbal Communication

Introduction to the Special Thematic Session

Andreas Kunz[1] and Klaus Miesenberger[2]

[1] Swiss Federal Institute of Technology, Zurich, Switzerland
kunz@iwf.mavt.ethz.ch
[2] Johannes Kepler University, Linz, Austria
Klaus.Miesenberger@jku.at

Abstract. This Special Thematic Session describes the elements of an IT system that allows for a better integration of blind people in a MindMap brainstorming session together with sighted users. Software components will be introduced that convert the parallel information visualization to a serialized information representation, which will then be output on a special blind user interface using screen reader and Braille display. Moreover, non-verbal communication elements are another important carrier of information, which also need to be captured and displayed to the blind user. Thus, this session also describes the necessary hardware components and the overall setup, which will allow for a more efficient teamwork in such a mixed team.

1 Introduction

Today, many devices exist that allow for an easier accessibility for blind people to digital content on screens. Braille displays or text-to-speech-software are typical tools for the blind user to interact with the content on the screen. However, these technologies are only of limited benefit for a collocated teamwork in the ideation process together with sighted persons.

Such teamwork in the ideation process typically goes along with a lively discussion between all participants, and the artifacts on the common workspace guide the way to a common solution for a given task. However, the discussion during such a teamwork is accompanied by non-verbal communication elements such as pointing, posture, gaze or facial expression. Together with the artifacts and the verbal communication, these non-verbal communication elements also carry a significant amount of information, which is partly unconsciously perceived and interpreted by the sighted participants. With exception of the audio channel, such information is not accessible anymore for blind people.

Consequently, such mixed groups attempt to consciously place more information on the verbal communication channel, which slows down the whole teamwork since is causes an additional cognitive workload. If the participants are not used to such a communication style, the working behavior typically falls back to a communication style that is less accessible for blind users.

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This situation becomes even worse, since blind users sometimes could also not use their text-to-speech output, since this might disturb other users or prevents the blind user from having full access to the ongoing verbal communication.

2 Session Goal

This session will present a new approach how blind people could be better integrated in such a brainstorming session within a mixed team of blind and sighted users. Using the scenario of a MindMap application on a common workspace to capture the volatile generated ideas and to guide the discussion within the group, new technologies and algorithms will be introduced in this session that allow a better integration of blind users. The application of a MindMap was consciously chosen, since it typically provokes a significant amount of non-verbal communication elements such as pointing gestures (and in particular deictic gestures). Moreover, this application also contains other situations, a blind user is typically confronted with, e.g. dynamic content of a common workspace, non-explicit artifact information such as clusters of objects or spatial distances, or on-screen interaction.

The session will discuss in detail, how current information technology can help to improve the overall information flow without the need for the blind user to learn new devices or technology.

3 Challenges to Be Addressed

Integrating blind users into such a MindMap-based brainstorming session imposes the following challenges that have to be met:

3.1 Parallel-to-Serial Conversion of Screen's Content

Visible content on a screen such as a MindMap can be parallel accessed by sighted users. They see the content written on the cards, their orientation to each other, but also clusters and other annotations. Such parallel information must be serialized in order to become accessible for blind users using their normal Braille display. Moreover, a MindMap is altered and extended during such a session, and thus continuously changes its layout and visual appearance. This implies that also these changes will be translated in order to be displayed to the blind users together with a corresponding change notification.

3.2 Capturing of Non-verbal Communication Elements

Non-verbal communication in the chosen scenario mainly consists of pointing gestures onto artifacts on the common workspace. A direct interaction with the MindMap elements on the so-called "Artifact Level" (e.g. for moving the elements) could be directly captured, if an interactive table such as PixelSense would be used. However, deictic gestures typically do not touch the surface and thus cannot be captured by the table's sensors anymore. Here, new sensors have to be integrated into the overall system, which offer a sufficiently high resolution for the detecting fingers together with their orientation and inclination. This is in particular important for deictic gestures, since they have to be precisely assigned to an artifact on the screen in order to avoid a wrong interpretation and translation for the blind user.

3.3 Sensor Fusion

Having various sensors in the technical setup would provide partially redundant information of different resolution. Such information – even though some signals might be noisy – can still be used to increase the overall system's accuracy by fusing the sensor signals. Since mainly deictic gestures are relevant for the chosen scenario, also multimodal sensor signals such as audio, artifact position, artifact content, and pointing orientation could be used to further improve accuracy. Saying "I mean this" for example will only give relevant information if it goes along with a pointing gesture. Carefully filtering and refining such information could help to avoid false alerts to the blind user, since not every pointing gesture would carry information and thus could be ignored.

However, such a sensor fusion also requires a complex data model, which supports various sensors, user applications, as well as models that contain the logical context of the complete system to guarantee the persistence.

3.4 Applications

As mentioned before, the chosen application consists of a brainstorming session, which uses a MindMap tool for capturing and visualizing volatile ideas. These common ideas should than be displayed on an interactive table as common workspace. This requires a MindMap software that can be simultaneously edited by the sighted users around the table, who can also rotate the artifacts, or cluster them in groups. The blind user can access this MindMao tool via the blind user interface, which shows a serial representation of the MindMap on the screen. Within this application, the blind user is also able to modify the tree, and all changes will then also be mapped to the MindMap tool on the screen.

3.5 New Input Procedure for Large Interactive Surfaces

So far, the blind user reads messages via the Braille display, and enters them over the regular keyboard, which is the most common interface. However, also applications for smart phones became very accepted within the last years. But using smart phones for entering text is still limited, mainly due their size and due to their missing haptic cues as feedback. On a first glance, it thus seems to be impossible to realize text input even on larger surfaces like tablet PCs or even interactive tables, as they exist in the chosen scenario. Here, new approaches are required that will use the system's intelligence to automatically adapt the keyboard to the blind user while he is entering text.

4 Summary

Within this session, a system was introduced in detail, which will allow for a blind user integration in MindMap-based brainstorming sessions. This system addresses several challenges that have to be overcome in order to capture and translate non-verbal communication elements, while also the blind user should have full access to the artifacts being generated on the screen during the discussion. The technical solutions in hard- and software were discussed in detail, which could build the basis for many other applications in this field.