Alternative Frameworks for Designing Web Interface and Applications for Visually Impaired Persons

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Abstract – At the present time, graphical user interfaces (GUI's) or visual interface paradigms are becoming the standard in the realm of computers and the internet. However, access to graphical user interfaces is a critical concern for the visually-impaired community. This presentation, therefore, discusses an alternative approach—Multimodality. In addition, two theoretical frameworks, distributed cognition and activity theory, that are useful for designing interfaces for people with visual impairment and their practical application are introduced. In order to identify a new approach for computer and web interface interaction and design for the visually impaired, the literature and theoretical conceptualization are reviewed. The findings suggest that both theories and multimodal approach are helpful for designing interfaces for visually impaired users

I. Introduction

Computer and web interfaces have continuously been developed, from the text-based interface, graphical user interface (GUI), and until now, the advent of multimedia and 3d internet. The main purpose of this rapid change is to increase usability and access as well as to provide a more enjoyable experience for users. However, it is undeniable that the evolution of interfaces is also a great barrier to persons with visual impairment [2,4,5]. Although many generic speech output devices have been developed together with the use of the keyboard in order to interact with graphical and nonvisual interfaces, this group of people still encounter many navigational and manipulation problems [1]. Moreover, even though the Braille display may be an alternative to output detailed information, there are several technical restrictions, and the tool is unable to respond quickly to dynamic changes in data[5]. The solution is not only dealing with translation of the graphical presentation into a nonvisual presentation, but also providing different user input mechanisms. As a result, general principles of developing distinctive sensations to aid object identification and providing constraints to facilitate navigation should be taken into account for both 2D and 3D natures of a Web interface along with novel approaches for the interface design. Therefore, this presentation discusses an alternative approach—Multimodality. In addition, theoretical frameworks that are useful for designing interfaces for people with visual impairment and their practical application are introduced.

II. Methodology

To identify a new approach for computer and web interface interaction and design for the visually impaired, the literature and theoretical conceptualization are reviewed. First, the multimodal access is discussed as a new solution for interaction and as a basis for interface design. Haptic sensation, in particular, is found to be a powerful approach for providing a new modality for interfacing with computer generated environments. Advantages as well as the practical implications of the multimodal solution are also discussed. Next, the presentation focuses on the two theories: distributed cognition (DC) and activity theory (AT) as the frameworks for interface design with an emphasis on the multimodal approach. Demonstration of each theory and the design conceptualization are closely investigated. Basic elements of interface design including navigation and manipulation, enhancement and usability tools are illustrated. Lastly, a brief analysis of each theory is summarized.

III. Results

Both theories and multimodal approach are helpful for designing interfaces for visually impaired users. Distributed cognition focuses on the interactions between people, artifacts and both internal and external representations as well as the processes that take place in an extended cognitive system. DC's approaches, especially embodied cognition and ethnography of distributed cognitive systems, are significantly useful. For example, by integrating multimodal access to the interface design (i.e. adding the haptic modality to an auditory environment), sounds will represent the nature of the tag touched while skin senses will relate to the manipulating environment, hence providing increased awareness of the position and meaning of each object displayed on the screen. Consequently, users will be able to maintain engagement of all their senses, without the fear of sensory overload. In addition, users will also gain more natural and enjoyable experience in navigation and manipulation, unlike using a conventional screen reader where their perception of the spatial representation of a page is often limited. Moreover, the "distributed information resources model" by Wright and colleagues [6] can be used to analyze interaction and how the differences between

alternative interface designs can be elaborately characterized.

Activity theory (AT) is another interesting theoretical framework for design. It provides a broad conceptual framework for describing the structure, development, and context of computer- supported activities. AT offers a descriptive framework which can be useful for outlining some of the major issues that need to be considered when designing web interfaces for persons with visual impairment. Designers or developers can have a better understanding and are able to classify the cognitive, physical and social processes involved in performing a specific task, and how those tasks can be related to a larger motivating activity. Since the structure of AT helps to simulate potential outcomes of possible events before making actions in reality, designers can envisage and design the interface that is the most effective and possible for users. For example, by integrating the multimodalism into the new interface, AT allows developers to consider the major components of the interaction design, (e.g. subject, object, tools, etc.) AT, however, will not directly tell how the interface should look, or what specific technology to use, but it will provide with a list of issues the technology should address and a clearer sense of the social framework in which the technology will be used.

IV. Conclusion

Technology has rapidly developed including computer interfaces; developers, therefore, need to be alert and open for novel methods in order to keep up with this advancement. Similarly, the technology for persons with visual impairment also requires continuing changes and new approaches so that this group of people will not be left behind. "Multimodal access" is one of the alternatives that allows blind computer users to independently access websites and other applications. This presentation illustrates how to integrate this approach into the interface design by applying two theoretical frameworks: DC and AT. It is noted that these two theories are very close in spirit: emphasizing cognition, both include the social and cultural context of cognition, and both share a commitment to ethnographically collected data. Nevertheless, they have some differences. For example, in AT, the perspective of the individual is at the center of everything whereas DC focuses on the socio-technical system. This makes the design frameworks and implementation different. DC helps to generate a body of comparative data on patterns of work practices in varying arenas. In contrast, AT only provides a useful framework for thinking about and identifying the larger societal influences on the individual's conception of their tasks and how to use specific tools to accomplish their larger activity driven goals. It does not actually dictate how the descriptive findings should be applied to the design of the interface [3]. Nonetheless, these two theories are very helpful for developers, and they should be mutually informed and applied together for a better design.

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