User interface design for visually impaired children

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The paper first summarizes questions related to partial sightedness, followed by the description of programs written in Macromedia Director 8.5. Three game programs are described that can be used to develop the sight of visually impaired children.

The main part of the paper describes a program, which was developed in the framework of ICT, where teachers can upload their materials to the server in a suitable form for normal vision and students can use them according to their special needs. Thus, each student can change the size of the letters, the colour of the letters and of the background, etc. This is a good help for visually impaired children to increase their communication and learning possibilities.

Keywords: visually impaired; multimedia; user interface; ICT

Design von User Interfaces für den Unterricht von sehbehinderten Kindern.

Die Arbeit fasst zuerst Fragen der Sehbehinderungen zusammen, dann werden Programme beschrieben, die mit Macromedia Director 8.5 erstellt wurden. Zuerst behandeln die Autoren drei Programme, die von sehbehinderten Kindern als Spiele aufgefasst werden, aber ihre Sehleistung fördern.


Schlüsselwörter: Sehbehinderung; Multimedia; User Interface; ICT

1. Introduction

In this paper we first summarize questions related to partial sightedness. Our aim was to develop programs that are attractive for children, provide interaction for them and feedback for the teacher, and can be adjusted to the individual needs of the patient. Following these propositions, we developed three multimedia programs.

All programs, developed by using Macromedia Director 8.5, have been tested in special schools for partially sighted children and in other special institutions.

After programming computer games for low-vision children we began to developed e-learning ICT to help the education of low-vision children. The e-learning web page has been developed in Macromedia Flash developer environment.

Based on our experiments we want to give useful advice for designers, discussing questions concerning the user interface design for developing multimedia software for low-vision children.

2. Background

In the early 1980s computers became more available in schools for visually impaired children (Blenkhorn, 1986) and a significant number of software systems were developed to support the assessment and training of visual skills (Blenkhorn, Tobin, 1983, Spencer et al., 1987). Although these systems tended to be used more informally and less systematically than packages such as "Look and Think", many teachers reported positive experiences with the children. Recently more systems have been produced for more modern computer systems. Such systems can be used to support a subset of visual skills, namely: awareness of vision as a sense, localization of visual stimuli, color vision, tracking and hand-eye co-ordination (Blenkhorn, Evans, 2001).

The Tactile Interactive Multimedia (TIM) (Archambault, 2000) is a project whose main objective is to offer visually impaired children of various levels of psychomotor development the possibility to play computer games in an autonomous way. The software gives a double role to the computer: ludic and educational. For some children, having additional disabilities, like cognitive troubles, it can have a third role: it functions as a therapeutic tool.

Many children who have damage of temporal or occipital lobe of brain sometimes suffer from visual perception disorders (VPD). Such persons who suffered from visual agnossias, agnosias of color, size discrimination disorders, prosopagnosia and hemineglecton of visual fields were rehabilitated by using various training appliances as color cards, drawn geometrical figures, objects, letters, painted pictures etc. The aim of the work of Ruseckaite and Lukauskiene (Ruseckaite, Lukauskiene, 2001) was to evaluate new methods for rehabilitation of VPD by using some type of computerized programs.
The number of partially sighted children increases year to year. Several games of different types (action, adventure, exploration...) have already been developed. There are also many instruments to be used by partially sighted people, including some very new solutions (Kobayashi, Watanabe, 2002), however, not for very small children.

The *visus*, i.e. how well the person can read the letters of a Snellen Table or other visual acuity test, of children can be improved by early training of their vision. Our programs build on the remaining vision of these children and help them in learning how to fixate on given targets and use their eyes to search for details. This is very important as with proper training the visus of the children can be improved considerably.

It is probably unnecessary to stress that for any person to be able to live a full life it is most important to have a vision that is as good as possible. Neither with the best methods of presentation nor with the most sophisticated equipment one can fully compensate a loss of vision. Thus it is most important to rehabilitate the vision of the children, and this has to be started at a very young age. This will help them to learn more easily in school, to get more information by roaming on the WEB, and finally to find a job more easily when becoming adult.

Later, when these children go to school, they have to use computers and internet, too. Most of the visually impaired users use text-based web browsers, or read on-line content with a speech-based system. Some people are able to read the screen content only with increased font size.

Nowadays the Web Content Accessibility Guidelines version 2.0 is the standard. There are some programs, based on these Guidelines that help persons with visual impairment. Such programs are, e.g.

- JAWS: It is a screen reader, which reads the web content aloud.
- MAGIC: It is a program that magnifies the screen.

The Web Content Accessibility Guidelines (WCAG) help to solve the problem, how a web page can become accessible for visually impaired users. The World Wide Web Consortium (W3C) creates Web standards, so they published the Web Content Accessibility Guidelines 1.0 (WCAG 1.0). The Working Draft for version 2.0 has the aim: to explain how to make Web content accessible to people with disabilities. Incorporating feedback on WCAG 1.0, this Working Draft of version 2.0 focuses on guidelines (Gulliksen, Haker 2004, W3C).

Approximately 22 % or 1 in 5 of the total school aged population requires special educational provision either in a mainstream classroom, or as part of a special class or within a separate institution (Watkins, Weber, 2002).

In the following we will describe our other goal, to design hompages for visually impaired users considering these guidelines. The appearance and accessibility of information can be set according to the user's demands. We analysed how charts, images, videos, animations and texts could be visualized in a more interpretable way for users with special needs.

3. Partially sightedness

First of all it is essential to clarify some concepts that are necessary to understand the meaning of partial sightedness and visual impairment. The term visual impairment is used to describe a slight or serious reduction of sensory function resulting from damage suffered by visual organs. Visual function includes specific perceptive abilities (visual sharpness, field of vision, sensitiveness to contrast, etc) each of which contributes in differing amounts to define the threshold of optimum perceptive functioning. As Khan and Chowdhury stated: "For example, visual sharpness and field of vision are two fundamental parameters, according to which a disability is recognized, in a proportionate measure. Visual sharpness means the ability to 'discriminate' in maximum contrast conditions, it is a question of evaluating the individual's ability to perceive the details of an image placed at the centre of his field of vision and in particular an object being looked at, it is measured from a distance and is evaluated with the best correction for each eye. If the eyes are both functioning, there is an improvement of visual sharpness (visus) in binocular vision" (Khan, Chowdhury, 2004).

The loss of vision is a psychological trauma to the partially sighted, nevertheless they would like to conduct a lifestyle similar to those with normal vision. To give them a chance of performing similarly to those with normal vision, they have to be helped in developing their skills; they have to be supported in their learning.

The expression *partially sighted* is a pedagogical expression describing groups of patients with impaired vision. The boundaries of the single groups of impaired vision can be defined based on ophthalmologic principles. Figure 1 shows the change of visus from normal visus to total blindness.

![Fig. 1. Visus values of different classes of impaired vision subjects](image)

The definition of partially sightedness differs from country to country, but it is usual to call those with a visus between 0.25 and 0.1 partially sighted. Deviations from these values can be found both at the lower and higher boundary. In some countries the higher boundary is at 0.33, and the lower boundary can be as low as 0.04. In Hungary the boundaries are at 0.3 and 0.1. One can see a tendency of lowering the lower boundary due to the fact that modern technical equipment can help the partially sighted in performing their tasks. By the help of special optical and tutorial equipment children with a visus between 0.1 and 0.05 (the class of almost blinds) can identify signs, thus can be helped to be able to "read." In recent years computers have gained in importance since they can be used in teaching of partially sighted children very effectively (OIE, 1997). Thus in determining the lower and higher boundary of the visus of a partially sighted person, individual evaluation is necessary. Important is whether the child can or cannot read and write – with the aid of special equipment – as well as children with normal visus.

4. Special needs of low-vision children to be considered when developing multimedia software

In some cases the low-vision patient sees only colored patches. It is very important for them that the single objects are well separated from each other. Therefore the objects have to be demarcated from each other. This demarcation can be achieved in several ways: One way is to increase the conspicuity of the contour lines of the objects by increasing their contrast, also their color contrast and the line-width of the contour line. It is important to use also large contrast between the object and the background. This can be achieved by selecting appropriate coloration and structure of the surfaces. The colors have great importance in developing vision, too.

Dini, Ferlino and Martinoli developed evaluation criteria to analyze the benefits of educational software for visually impaired children (Dini, Ferlino, Martinoli, 2004). Some of these