SCREEN READERS FOR THE BLINDS BASED ON VISUAL AREAS PROPERTIES

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ABSTRACT

This paper deals with questions about people with disabilities on the Web. Most of them have visual disability, so they have to use screen readers for reading the page content. This paper shows new method how to solve the biggest problem of screen readers – the reading order.

1 INTRODUCTION

Life without Internet connection is for most people today unimaginable. Whole world is through Internet very easily accessible: News, e-shops, e-mails etc. This paper describes, how people with some disabilities use the web.

2 PEOPLE WITH DISABILITIES ON THE WEB

The Internet is one of the best things that ever happened to people with disabilities. Before the Internet, most blind people didn't read newspapers. Braille printouts and audiotapes were very expensive and not ever available. Online newspapers has the potential to be read by *screen readers* [1]. Screen readers are applications that are able to read electronic documents, so all electronic newspapers are available for blinds as soon as the content is published on the Internet.

Similar situation is at people with motor disabilities. For this people it's absolutely impossible to pick up newspapers and turn its pages, so they use certain assistive technologies to help to adapt the computer interface to their own disabilities.

About one fifth of the population has some kind of disability. Not everybody from this group of people have problems with accessing the Internet, but it's quite high percentage of the population. The major categories of disability types are:

- visual (blindness, color-blindness, low vision)
- hearing (deafness)
- motor (inability to use a mouse, slow response time)
- cognitive (learning disabilities, distractibility)

Most of them (more than 90%) have problem with eyes – blindness, low vision, visual impairment. That's the reason why I research this area.

3 BLINDNESS

People who are blind are not able to see things, althought it's true that most blind people do have some degree of vision. But the vision of people who are blind is not useful enough for accessing the web.

4 SCREEN READERS

There are computer applications that convert text into synthesized speech, so blind people are able to listen to Web content. Screen readers allow user to navigate through Web content in many ways. The first option is to let the reader to read whole page from top to bottom, one line at a time, from link to link, from one heading to the next, from one frame to the next one, or by other methods.

Screen readers can also be used by those who are both deaf and blind – screen readers for the deaf-blind convert text into Braille characters on refreshable Braille devices. These devices have small pins that can be raised or lowered to form Braille characters which the deaf-blind individual can feel.

5 SCREEN READER LIMITATIONS

Screen readers have some limitations:

5.1 VISUAL LAYOUT

A visual user can look at a web page and quickly realize how the page is organized, so he/she can quickly start reading from most important content. Today screen readers are not able to do this. They can't skip over extraneous content (advertisement, navigation bars, etc.).

5.2 IMAGES

A screen reader can convey the meaning of an image only by reading substitute or alternative text for that image. Without at least one of these text informations, screen readers are not able to convey the meaning of an image.

5.3 DATA TABLES

Screen readers read linearly, so that seems to be impossible to recognize heading for tables with more than ten columns when the table content is read.

Detection of visual layout is the most important point to solve. Next chapters describe procedure how to recognize areas contained in Web-page. The procedure is based on visual area properties.

6 DOCUMENT PREPROCESSING

Input documents for detection of visual properties are web-pages. All principles shown in this paper are able to work also on another types of documents, for example PDF, PostScript, DOC, RTF, ODF and others, that contain textual information [3]. There are another problems to solve in raster images, so this paper doesn't deal with image documents.

The first step of preprocessing is reconstruction of final document representation. There is done by rendering machine constructed on FIT BUT. Than, the output from the rendering machine is used as an input for visual segmentation algorithm, that spreads out the document into hierarchical structure of visual areas.

7 VISUAL AREA PROPERTIES

Investigated properties of visual areas detected in the segmentation algorithm are as follows [4]:

- *font size* – average font size in the document is 100%
- *font weight* – normal or bold
- *font style* – normal or italic
- *number of areas that are above, below, on the left and on the right*
- *number of characters, spaces, numbers, lower case and capital letters*
- *relative position within the document*
- *color markedness*
- *markedness*

7.1 COLOR MARKEDNESS

Color markedness is the color importance in the document. RGB color model is for color importance detection absolutely unsuitable, because we can't determine from RBG values how expressive the color is. HLS color model was chosen from all applicable models as the best one (Figure 1). In HLS color model there are following attributes: Hue defines the color itself, for example, red in distinction to blue or yellow. The values for the hue axis run from 0–360° beginning and ending with red. Saturation indicates the degree to which the hue differs from a neutral gray. Value *1* means the fullest saturation. Lightness indicates the level of illumination

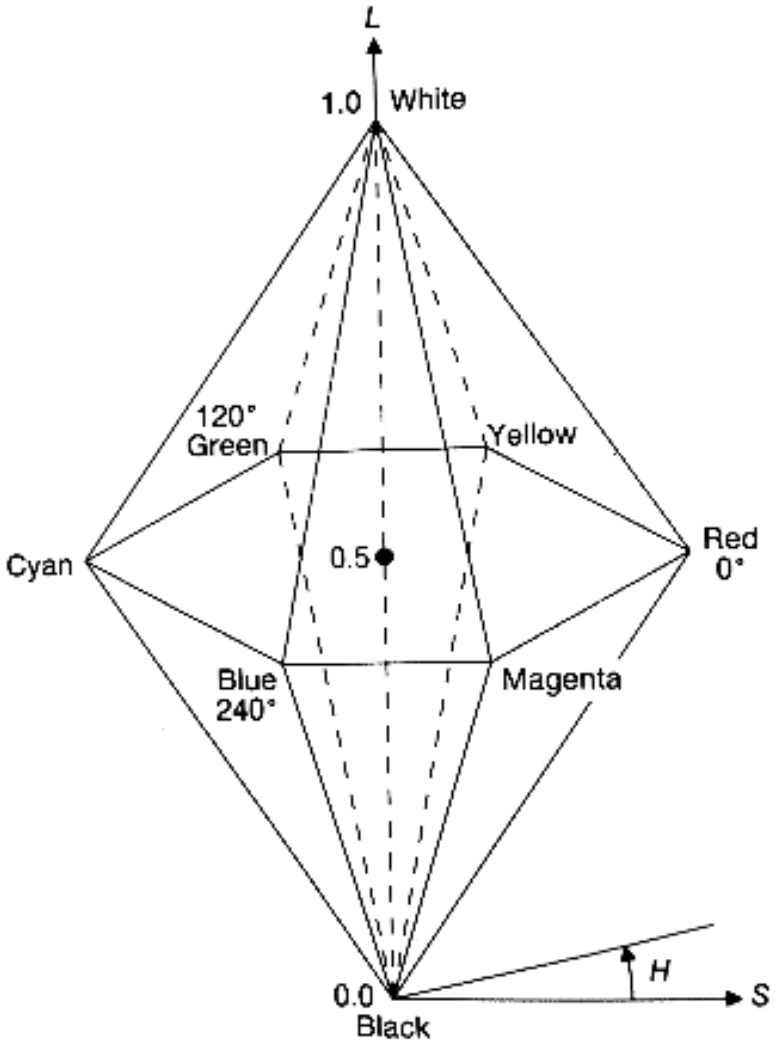

Figure 1: HLS color model [2]

from *0* to *1*.

The most important colors have following characteristics: $saturation = 1$ and $lightness = 0.5$. For color markedness enumeration there was established formula:

$$C = s * a * exp\frac{-(l-b)^2}{c},$$

where C is color markedness, s is saturation, l is lightness and a, b and c are parametres of Gaussian distribution: $a = 1$ is the maximum height, $b = 0.5$ is the middle (inflex point) and $c = 0.05$ is the dispersion.

Color markedness should be useful for table heading recognition, that is one of the today's screen reader limitations.

7.2 MARKEDNESS

The final markedness of some document area is computed as follows:

$$V = \frac{fontsize*100}{avgfontsize} + \frac{weight}{2} + C,$$

where V is the markedness, $fontsize$ is the size of font in surveyed area, $avgfontsize$ is the average font size in whole document, *weight* is 1 or bold and 0 for normal and C is color markedness.

The value of markedness determine how visually important the area within the document is. It means, that we can detect visual layout of some page. The page should be read from most important parts (main headline, menu, second level headlines etc.) to less important parts (advertisements, banners etc.). This is the new challenge for today's screen readers.

8 CONCLUSION

Internet connection is available almost everywhere. People with disabilities can't browse its content as easy as people without any disability. Visual disabilities are the most widespread. These people use screen readers for reading the document content. The biggest disadvantage of screen readers is the way how they read the document – from top to bottom. This paper shows a method how to determine, which document areas are visually the most significant so if the screen reader will use this technology, the page should be read from most to less significant areas. The method will be now tested for large group of web pages.

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