

Toward an Enhanced Reader for Dyslexics

Nadia Mana
Fondazione Bruno Kessler (FBK)
via Sommarive 18
38123 Trento, Italy
{mana@fbk.eu}

Ornella Mich
Fondazione Bruno Kessler (FBK)
via Sommarive 18
38123 Trento, Italy
{mich@fbk.eu}

ABSTRACT

In this paper we present a work-in-progress concerning a tool to support dyslexics while reading an e-text. Our tool is mainly based on four actions: the personalization of the text format, the use of audio pre-recorded or generated by a vocal synthesis system, the proposal of visual, dynamic and audio dictionaries, and the processing of the reader's attention by means of an automatic attention module. This is based on head, eye and pressure tracking, when readers lose attention, the latter is recaptured by acoustic and visual stimuli, as well as by an automatic audio reading restarting from the sentence where the attention has been lost.

Categories and Subject Descriptors

H.5.1 [Information Interfaces and Presentation]: Multimedia Information Systems – *animations, artificial augmented and virtual realities, audio input/output, evaluation/methodology, hypertext navigation and maps, video (e.g., tape, disk, DVI).*

General Terms

Design, Experimentation.

Keywords

Reading tools, dyslexia, automated attention detection, personalization.

1. INTRODUCTION

According to recent statistics, 5-10% of the European population is affected by dyslexia [3].

Dyslexia is a severely invalidating learning disability related to reading. It does not imply low intelligence or poor educational potential but it strongly affects literacy acquisition. This disability is often characterized by difficulties with word recognition, decoding and spelling. Such difficulties negatively impact on reading comprehension and slow down vocabulary growth.

Although its causes are still widely debated, most of researches agree on considering reading as one of most efficient ways to overcome this disability [7]. However, the difficulties met during the reading, mainly characterized by poor reading fluency, poor

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reading out loud and several reading errors, discourage the dyslexics to practice it.

People with dyslexia are abnormally affected by *crowding*, a perceptual phenomenon with detrimental effects on letter recognition [1]. Since letter identification is fundamental for good visual word recognition and reading aloud, crowding strongly impacts not only on reading speed but also on reading errors. However, letter recognition may be modulated by spacing between letters [1]. In particular, recent studies (e.g. [5], [10], [8]) have demonstrated that a simple manipulation of the letter spacing, as well as specific fonts, can considerably reduce the crowding phenomenon and improve text reading performance of dyslexic children. In addition to a distorted perception of the texts, dyslexics suffer a visual irritating glare from white pages. Therefore, it is preferable for them to not use white background or, more generally, to reduce the contrast between written text and background [2].

Dyslexics also have typically memory and attention problems [4]. These problems entail inaccurate reading with spelling errors and omission of words, high degree of distractibility and frequent loss of the place when reading. Audio files, pre-recorded or automatically generated by vocal synthesis, combined with word highlighting, significantly help in keeping attention and facilitate text reading and comprehension [4].

Although having neurological and often genetic origin, the difficulties connected to dyslexia can be mostly overcome with proper strategies [7]. From this prospective, assistive technology based on hardware and software applications can be a valuable and efficient support for dyslexics, tailored on their specific needs.

2. SYSTEM DESCRIPTION

Aiming at developing a tool to support dyslexics while reading an e-text, we focused on the aspects concerning: a) text visualization; b) reading supported by prerecorded audio, text-to-speech synthesis and corrector based on recognition of words read aloud; c) comprehension supported by a good vocabulary; and, d) attention tracking and recapturing.

In particular, the system is designed on four main tasks (see Figure 1): a) Personalization; b) Reading; c) Vocabulary Expanding, and d) Attention Processing.

Personalization: this task is focused on changing of the text visualization in order to make easier the text reading, according to specific personal user needs. The personalization is accomplished by five main actions: change of a) font size, b) font and background color, c) character spacing, d) word spacing and e) line spacing.

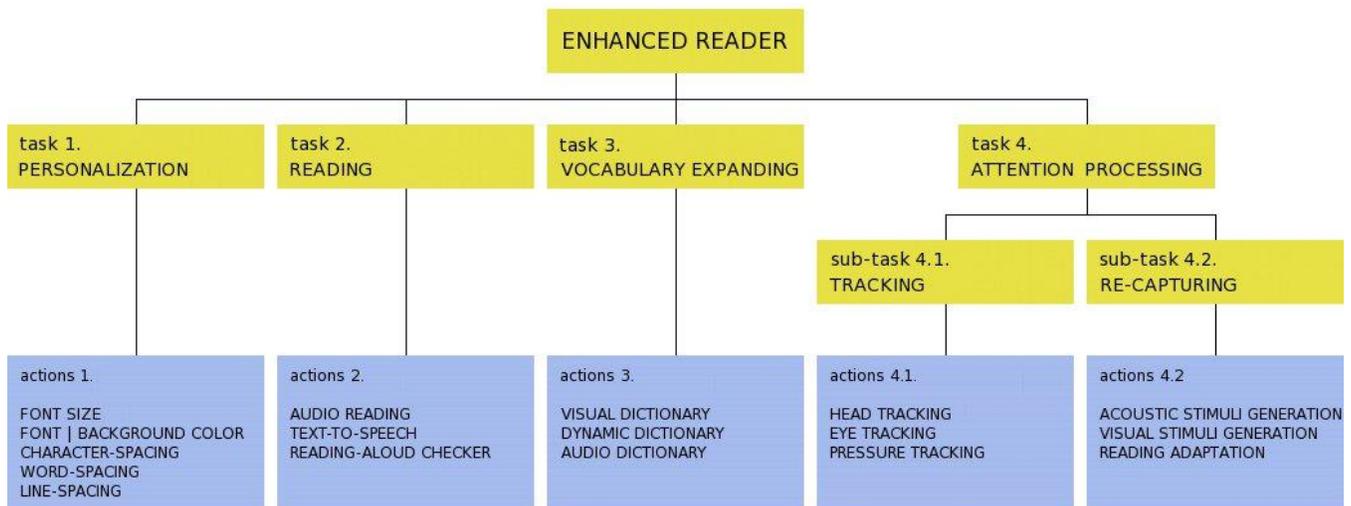


Figure 1. Task analyses of the system

Reading: the text reading is facilitated by hearing a) audio files pre-recorded containing the voice of a person reading the specific text; or b) a voice generated on any texts by text-to-speech synthesis. In both cases, the word read is highlighted, so to help the reader to better follow the voice with attention while silently reading. In addition, reading aloud is made more effective by a checker based on speech recognition that corrects the reader in case of reading errors.

Vocabulary Expanding: the reader's vocabulary is consolidated and expanded by visual, dynamic and audio dictionaries, respectively providing images to illustrate words, short explanatory videos and audio files to listen to the correct pronunciation.

Attention Processing: this processing is based on two main sub-tasks: a) attention tracking; and, b) attention re-capturing.

Lack of user's attention may be detected by means of head orientation [5] and eye tracking, capturing when the reader gaze is out of the page. In addition, the attention level may be also measured by pressure sensors placed on the chair.

When the system detects possible lack of attention, it generates acoustic and visual stimuli on the interface to draw the reader gaze again on the page. At the same time, to facilitate the reading, the audio playing, or the synthesis generation is interrupted: they start again when the reader gaze is on the e-text, from the sentence interrupted.

3. CONCLUSIONS

The system presented in this paper aims to support dyslexics in reading, exploiting speech processing technologies and attention capturing techniques in innovative ways.

The system has been designed according to a user-centered design approach, collaborating with experts of AID (Italian Dyslexia Association). It is focused on four main tasks: a) Personalization; b) Reading; c) Vocabulary Expanding, and d) Attention Processing.

The first task has been already accomplished. A preliminary study, conducted on 9 children, has confirmed the positive impact of proper changes of text visualization. Implementation and evaluation of the other system modules are in progress.

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