Improving Static Print Design Readability Using Mobile Reading Filters

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Abstract. This work proposes the use of mobile computer cameras as an alternative assistive technology for people who do not read easily. It attempts to explore mobile camera software options to improve readability, making use of well known reading filters concepts. A proof of concept of this work is demonstrated by the implementation and demonstration of a mobile application prototype that applies various real-time filters to the viewfinder.

Keywords: Readability, mobility, visual impairments, accessibility.

1 Introduction

Either due to visual impairments or contextual adversities, many people may find difficulties to read or to recognize general symbols. These situations exclude cognitive impairments (neurodiversity), and can be supported by a number of assistive technologies driven by regulations or best practices documents [1]. They cover a wide range of recommendations for making design content more accessible. They apply to design pieces to be seen through digital media or prints. Digital design count on advanced image processing solutions, available on desktop PCs, notebooks, handhelds, mobile phones and basically anything with an digital display, in order to make the reading process more accessible, when rendering the content. However, print design – books, posters, signs - has much less assistive solutions to count on, due to its static nature.

2 The Problem Space

Image processing techniques can be easily applied to digital content when manipulated by the end user, in order to make it more accessible. However, static print design represent a different scenario, where no dynamic assistive technology can stand between the eye of the reader and the reading object. Therefore, all recommendations from regulations or best practices documents should be applied prior to publish. After that, the design piece is subject to contextual adversities such as low light or color light, poor-quality print, or visual impairments.

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3 Mobile Reading Filters

As we watch the transition of the mobile phones to mobile computers, many fronts of interaction research arise. Mobiles (phones) are smoothly changing the way people interact with computers. The philosophy behind Personal Computers is getting even more personal. Not only as a data processing unit, mobile computers gather mobility and a wide variety of connectivity options. In addition, a growing list of sensoring options (cameras, microphones, touch screens, accelerometers, etc) enriches the user's perception of the environment. Therefore, phones are becoming empowered to be seen as a potential assistive technology, for many different disabilities.

The phone cameras have been used as assistive technology for the visually impaired on prior works, as in [10]. This work presents a camera phone-based currency reader that can identify the value of U.S. paper currency.

The cameras embedded to mobile phones have many configurations options that involve known readability improvement concepts such as brightness, contrast, gamma, hue, sharpness, saturation, focus range, zoom factor, etc.

4 Use Cases

As a general classification structure, the WCAG 2.0 [1] Principle 1: “Perceivable - Information and user interface components must be presentable to users in ways they can perceive” and its sub-item, Guideline 1.4 “Distinguishable - Make it easier for users to see and hear content including separating foreground from background” will be considered. It states general recommendations on how to make design content more accessible, from the readability point of view.

The following criteria of the guideline 1.4 will be used (the missing items are audio related):

- 1.4.1 Use of Color [2] – Apply filters that will affect the colors: negative and saturation.
- 1.4.3 Contrast (Minimum) [3] – Apply filters that will affect the contrast: contrast and exposure compensation.
- 1.4.4 Resize text [4] – Apply filters that will magnify the image.
- 1.4.5 Images of Text [5] – This item is related to using text over images of text. In printed media, there is no such distinguishment. Therefore, this item does not apply to the use of filters.
- 1.4.6 Contrast (Enhanced) [6] – will be treated the same as 1.4.3.
- 1.4.8 Visual Presentation [7] – this item is related to alignment and layout, properties that cannot be changed in printed media. Therefore, this item does not apply to the use of filters.
- 1.4.9 Images of Text (No Exception) [8] - will be treated the same as 1.4.5.

Example use cases will be taken from the everyday life and will be related to the intersection between the criteria mentioned above and the mobile filters. The application is installed on the mobile and runs on the background of the operating system and it can be brought to foreground by the touch of a button or by the selection of an icon on the menu.

The following filters can be applied in order to adjust the reading perception according to the criteria: Magnify, (Color) Saturation, (Color) Negative, Contrast, Exposure compensation.

4.1 Medicine Facts Label – First Reading Use Case

This is a situation where the information to be read is critical and it is typically displayed with dark font and light background, providing maximum contrast. However,

Fig. 1. Applying magnification only

Fig. 2. Applying magnification and contrast

Fig. 3. Applying magnification, contrast and negative

the font size is generally too small due to essential information to be printed in small areas, e.g., nutritional facts in food packages, electronic devices manuals, buying receipts, etc.

4.2 Boarding Pass–Second Reading Use Case

This is a situation where the information to be read is printed in a background that is watermarked, causing an overall low contrast. This situation can be easily identified in design pieces where the information (text) is not highly prioritized, e.g., institutional folders, technical magazines, etc.

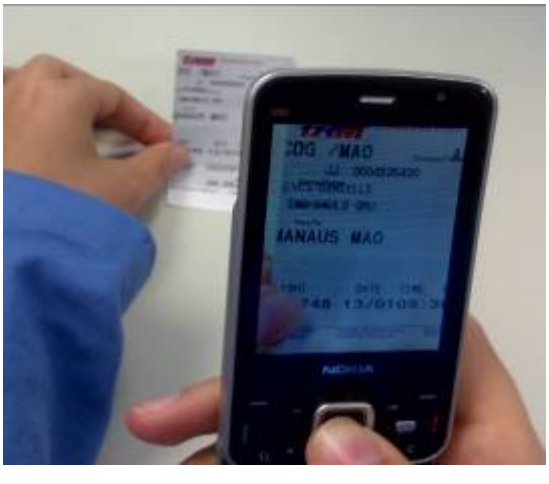

Fig. 4. Applying magnification

Fig. 5. Applying magnification and contrast

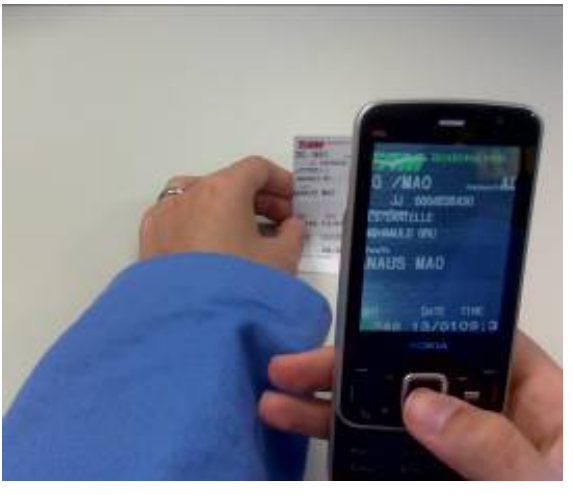

Fig. 6. Applying magnification, contrast and negative

4.3 Magazine Advertisement–Third Reading Use Case

This is a situation where the graphic composition has a strong esthetical appeal, hindering readability and causing communication noise. This situation can also be identified in careless color compositions or design pieces poorly planned.

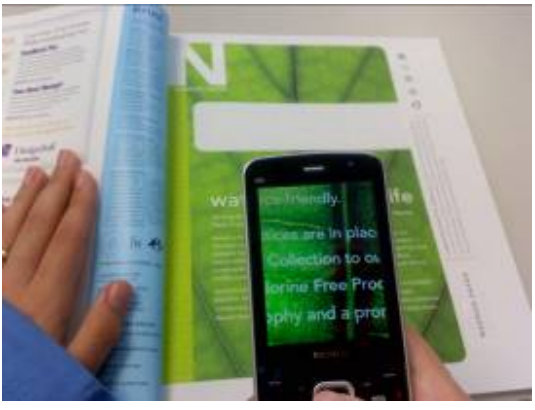

Fig. 7. Applying magnification

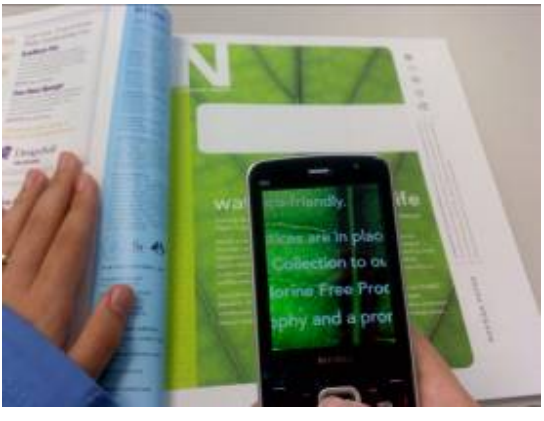

Fig. 8. Applying magnification and contrast

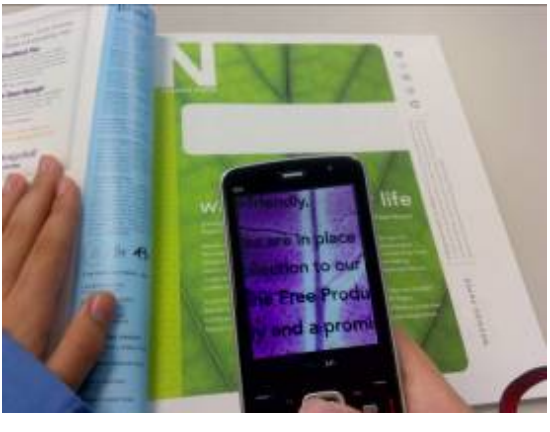

Fig. 9. Applying magnification, contrast and negative

5 Results

This work was motivated by the improvement of reading conditions by the development of an application the uses the mobile camera to apply real-time filters to the viewfinder [9]. The experiments were conducted according to everyday life reading situations. The selection of the use cases were driven by the variations of foreground and background compositions. Each use case represented a different combination of contrast, saturation, font sizes and colors, background design, etc. Specific sets of filters were applied to each use cases, in order to improve readability.

The application is based on well known mobile camera filters, providing an easy to use interface for reading static print media through the mobile camera viewfinder.

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