Comparison of Two Swarm Intelligence Optimization Algorithms on the Textual Color Problem for Web Accessibility

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Abstract. Currently, web accessibility is not a major concern of webmasters while creating web sites. For disabled people, it rapidly becomes an obstacle to inclusion in the society. Identifying and circumventing existing barriers constitute an important research topic. In this work, we are concerned with the problem of color accessibility of textual contents in web pages. In many cases, the textual colors of a web page do not respect the minimum constraints defined by recommendations like WCAG 2.0. For example, WCAG 2.0 requires that a minimum difference of brightness, tonality and contrast is ensured. Using the Smart Web Accessibility Platform, we try to transform the colors using a client-side HTTP proxy the best possible while retaining a reasonable access time for the web content. To solve the textual color problem for accessibility, we adapt two swarm intelligence based optimization methods (ABC and API) and we hybridize them with a line search.

Keywords: Accessibility · Assistive technology · Recoloring · Web · Swarm intelligence based optimization · ABC · API

1 Introduction

Web accessibility is a big concern for disabled people when accessing Internet. While Internet contributes to the insertion in the society, it can leads to exclusion when it is not accessible. To reduce exclusion, active or passive accessibility can be used. Active accessibility consists in a pro-active approach relying on norms, recommendations\(^1\), laws\(^2\), tools and methodologies\(^2\) to enforce a proper structuring and tagging of documents during their creation by webmasters. While it is the ideal way for achieving accessibility, in practice, a fully accessible web is not possible mainly due to limited implication of webmasters or external constraints (money, time...). Moreover, many web sites are unmaintained or ageing. Passive accessibility consists in using assistive technologies

\(^1\) http://www.w3.org/TR/WCAG10/, http://www.w3.org/TR/WCAG20/
and transformation tools to allow a better access to web contents. This form of accessibility is our concern in the project Smart Web Accessibility Platform (SWAP)\(^3\) that we develop. It is a set of open source modular components and tools designed to facilitate content transformation (the proxy tool), to store and to share global knowledge and to create metadata (annotations...) on web pages. A more detailed description of the project can be found in [3]. In this work, we are concerned only by the proxy tool. It is located on the user computer and is used by the browser to access Internet. On request of the browser, the proxy fetches the content on Internet, applies transformations on the page and sends the modified page to the browser. It allows to transform any content passing by the proxy (even secured ones) and to preserve existing user assistive technologies (speech synthesis, zoom...) so increasing the adoption of our tool. The transformations do not aim to make the content accessible for the average disabled user but for specific user needs: we transform only what the user wants and needs. The transformations are done on the fly while the page passes by the proxy. For ergonomic reasons, the user can not wait too long. Moreover, a perfect improvement of the content is not possible due to the lack of information on the contents. Consequently, the transformation of the content using the proxy tool is a time limited and imperfect process. However, a partial improvement of the content is nevertheless a big improvement for the user.

In this work, we are focused on textual color improvement which can be formalized as an optimization problem. In previous works [4–7], we considered simple heuristics and metaheuristics to solve the problem and a fitness function prioritizing four measures and using an integral and a fractional parts formulation. This fitness function while allowing a huge improvement of the colors suffers a big practical defect. It introduces discontinuities leading to color schemes which are equally ranked but which can be very different. From a user perspective, the important changes on the color schemes, each time the user access the same web page, is an issue. From now, the fitness function is modified into a weighted function of the four measures on the color schemes. It produces more stable color schemes over time at the price of eventually reducing constraints satisfaction. In the following, we define the textual color problem, its specificities and how it can be solved with three swarm intelligence based optimization methods.

2 The Textual Color Problem for Accessibility

2.1 Textual Colors Accessibility

The accessibility definitions considered are defined by WCAG 1.0 and 2.0 (Web Content Accessibility Guidelines)\(^1\). In the following, colors are considered in the sRGB space. To be accessible, the foreground \((f)\) and background \((b)\) colors of any text must satisfy three constraints: a minimal brightness \((\Delta B(f,b) \geq \eta_B)\), a minimal tonality difference \((\Delta T(f,b) \geq \eta_T)\) and a minimal contrast \((\Delta C(f,b) \geq \eta_C)\). \(\eta_B\), \(\eta_T\) and \(\eta_C\) are the accessibility thresholds fixed at 125, 500 and 7 in

\(^3\) https://projectsforge.org/projects/swap