# Empathy-Centric Design of a System to Evaluate and Repair Accessibility Barriers

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This paper presents a proof of concept of an accessibility evaluation tool, *EmpathicEditor4Accessibility*. The tool was built upon Semiotic Engineering (SemEng) principles and following a User Centered Design method. SemEng provides tools to analyze interactive systems' communicability, and offers a new perspective on how designers can match the user's mental model in their messages. User Centered Design method helps designing system more fit to users' needs. The tool's target users were prosumers, and the goal of the system was to communicate to them how to create web content with a strong awareness of the needs, preferences and difficulties of several user profiles such as blind people, people with a hearing impairment, people with cognitive disabilities, people with motor disabilities… The resulting tool, tries to facilitate empathy with accessibility problems, to foster the creation of accessible content and improving the accessibility user experience. The communication design and the empathy built into the system makes the tool suitable for non-technical audiences with no previous knowledge on web development.

**CCS CONCEPTS** • Human-centered computing (HCI) • Accessibility systems and tools • Accessibility design and evaluation methods

**Additional Keywords and Phrases:** Empathi

## 1 INTRODUCTION

About 15-20% of the global population has some type of disability [1], but all this people also has the fundamental right to access to web information and services [2] to actively participate in society through services, procedures and information critical for their day to day. An accessible web is the only guarantee that web, technology, and tools will offer no barriers for people with disabilities [3]. In many countries, there is a strong regulation over web sites to comply with minimal access requirements [4][5]. Although regulation is a clear indicator of commitment by governments and other institutions with accessibility, studies from the European Commission [6] or from independent consultancies such as WebAIM [7] report that less than 10% of web sites are compliant . This low rate may suggest that there are other problems to reach full accessibility apart from technical knowledge, maybe related to a misunderstanding of its impact or a lack of deep understanding of standard requirements [8][9][10]. Currently, web content is not only created by web developers but millions of users are feeding social networks, blogs and company websites with text, images, videos on several platforms or CMS. These systems do not require web programming skills. We call these users "prosumers" [11] which means content consumers and content creators at the same time. This is an additional burden for compliant websites, as these users rarely know if their content

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may create some kind of barriers [12] adding additional risks regarding accessibility. On the one hand, CMS themselves may not provide appropriate support for developing accessible websites, and including or modifying Web content by unskilled users may lead to a situation in which accessible websites can turn into non accessible.

To solve the gap between established requirements and current practice, a proof of concept of an accessibility evaluation tool, *EmpathicEditor4Accessibility*, was built. The tool was developed upon the Semiotic Engineering (SemEng) principles and following a MPIUa User Centered Design methodology [14]. SemEng [13] provides tools to analyze interactive systems' communicability and offers a new perspective on how designers can match the user's mental model in their messages. The tool's target users were prosumers, and the goal was to communicate to them how to create web content with a strong awareness of the needs, preferences and difficulties of several user profiles such as blind people, people with a hearing impairment, people with cognitive disabilities and people with motor disabilities.

This document is structured as follows, it starts with related work, followed by presentation and asses of the system *EmpatichEditor4Accessibility* and finally conclusions and future work.

## 2 RELATED WORK

Other systems exist that try to build empathy with accessibility barriers; among them, web extensions like Funkyfy [15] and the Web Disability Simulator [16] that simulate different disabilities as perceived by people, are very popular. Empathy may be defined as the "Ability to identify yourself with someone else and share their feelings" [17][18]. The first step to feel empathy is to be aware of the other's feelings. This was the main goal of the developed tool: to communicate the feelings of frustration or happiness experienced by users with disabilities when interacting with a specific content. SemEng states that Human Computer Interaction is nothing else than a two persons dialog materialized through a system interface, where the computer acts as a communication channel [19] [20]. In social networks or CMS content, prosumers (senders) create the content that the person with a disability (receiver) will get. SemEng seeks to improve communicability, defined as an efficient and effective method to transmit designer intentions to users through their proxy (the software system). Communicability is evaluated through a deep analysis of interface messages as they are perceived by users. Because the designer is not present at the time of the dialog, and the interface must act as a signification system for the communication, tell users what they can do, how to do it, and why [21].

As a previous research to build the system, several user tests with people with disabilities were held. We grouped the users in clusters following [22][23]. The focus of each test was to understand the impact accessibility barriers have on the emotions of people with disabilities. We carry out tests with people with cognitive disabilities [24], blind people and people with low vision [25], people with hearing impairments [26], and people with motor impairments [27]. During this research the authors recorded comments, experiences, expressions and moods in real situations facing accessibility barriers. Moods were classified with emoticards [28] (see Figure 1): Excited-Lively and Cheerful-Happy (for energized-pleasant), Tense Nervous and Irritated-Annoyed (for energized-unpleasant), Calm-Serene and Relaxed-Carefree (for calm pleasant), and Bored-Weary and Gloomy-Sad (for calm-unpleasant). Interviews and observations were the basis to define several Personas [29] used later to communicate the evaluation from a personal standpoint. The result of all the tests reveal which elements were the major causes of frustration to each user group, and how disabled users displayed

less criticism than expected to the barriers [30]. For instance, a blind person, shows boredom when he can not know the content of an image due to the lack of alternative text; similarly, a deaf person, shows also boredom when he can not understand the content of a video due to the lack of subtitles. A possible explanation for this soft behavior is "learned helplessness" [31], i.e. these users had learned from previous experiences that an aggressive reaction had no effect.

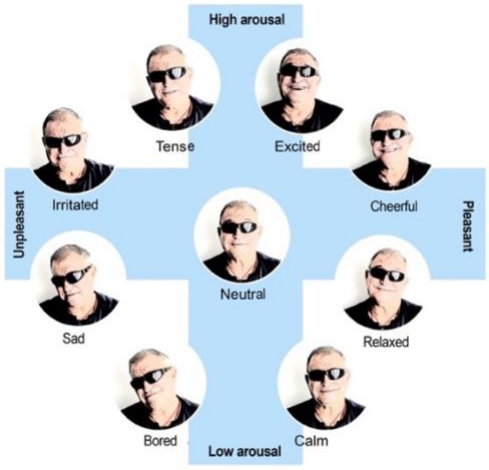


Figure 1: Images of the different emotions of one of the people with disabilities.

## 3 DESCRIPTION OF THE SYSTEM *EMPATICHEDITOR4ACCESSIBILITY*

The system, *EmpatichEditor4Accessibility*, has two main goals: 1) Communicate accessibility barriers in a more empathic way, offering a personal perspective of accessibility barriers built upon real people's perception. 2) Offer automatic repairs and specific suggestions to improve the accessibility of the content, just before the publication of a content on a CMS. Figure 2 shows a preliminar sketch of the tool. Since the beginning we created "Personas" that were used as an interface element to facilitate empathy.

The *EmpatichEditor4Accessibility* has an internal data base which relates access barriers [32]; WCAG guidelines [33]; and users affected, describing the impact on the mood and the severity (all these data were collected and synthetized from user tests with people with disabilities described before). This data base is the heart of the system that provides all the messages showed on the interface.

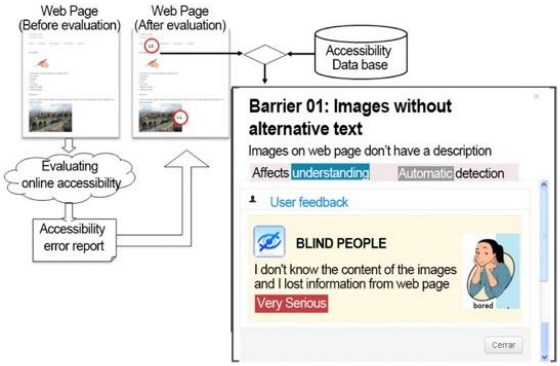


Figure 2: EmpatichEditor4Accessibility system preview diagram

The *EmpathicEditor4Accessibility* works as follow: First, the content is introduced by the prosumer, and before publishing it on the Web, the system *EmpatichEditor4Accessibility* follows different steps in order to know, communicate and fix the accessibility problems of the content.

- **Step 1**. The content created by the prosumer is evaluated by an automatic evaluation tool (in this case, we used IDI Web Accessibility Checker API [34]) to test accessibility success criteria under WCAG 2.0. As a result of this evaluation a list of WCAG guidelines with errors is generated and they are stored on the data base.
- **Step 2**. The system automatically analyses the errors from the WCAG guidelines and groups them by barriers, following the barrier walkthrough methods [32].
- **Step 3**. Messages and information to fix each content barrier are organized and displayed on the interface. All information come from the

data base system within *EmpatichEditor4Accessibility*.

- **Step 4**. Prosumers can navigate on the interface in order to know each barrier of accessibility and fix them.

  For instance, there is an image without alt tex (criteria 1.1.1 from WCAG), this is related to a barrier of a blind person, this barrier is related to boredom. The *EmpatichEditor4Accessibility* provides messages to communicate the problem (Figure 3), "*Cesar Cerezo (the blind Persona) is bored because he can not understand the image content*. In order to fix the barrier, the system *EmpatichEditor4Accessibility* shows a form to allow the prosumer to add a descriptive text. Figure 4 shows a title for the specific problem, shows the web element causing the difficulty and step by step instructions on how to solve the problem. The instructions are tailored to each problem. When the alt text is introduced *EmpatichEditor4Accessibility* adds it to theHTML code.
- **Step 5**. When the prosumer has solved all the accessibility barriers, he can publish the content without accessibility problems. A demonstration of the system is available on the following video: https://www.youtube.com/watch?v=vrFQZ06i5cc

  The video is divided in two parts. Firstly, it shows how to create a content in a CMS (without the *EmpatichEditor4Accessibility* system) and publish it. But when evaluating the accessibility of these content, it is observed that there are accessibility errors related with images without description and link titles. However, if the user wants to fix these problems and provide accessibility features to the content, he/she should either use the CMS interface directly or edit the HTML code. Secondly, the video shows how a prosumer adds the same content to CMS, but now with *EmpatichEditor4Accessibility* active. Before the final publication of the content, a previous evaluation of the content is carried out and the systems indicates the possible affected users. When accessing the blind person's profile, it is possible to observe the barriers that directly impact this kind of users, their mood when interacting with this barrier and an explanation of how the barrier or access problem could be solved. When the problems are fixed, it can be seen how the *EmpatichEditor4Accessibility* system no longer shows any access barrier. In the final part of the video, it shows how the content created by the prosumer can be perceived by a group of users with disabilities. The different profiles of users with disabilities in the *EmpatichEditor4Accessibility* system are also presented.

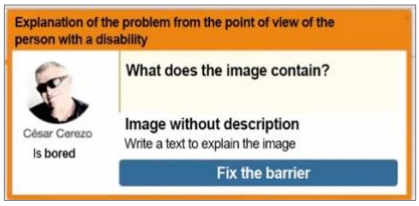


Figure 3. Barrier information display


Figure 4. Example of barrier repair visualization.

## 4 EVALUATING THE SYSTEM EMPATICHEDITOR4ACCESSIBILITY

For the development of the *EmpathicEditor4Accessibility* system we first carried

out different iterations in phases of requirements analysis, design, prototyping and evaluation following MPIu+a methodology [35]. In order to consolidate and observe how the messages offered in the developed prototypes of *EmpathicEditor4Accessibility* were perceived, an user test was carried out with 8 prosumers. The focus was to analyze the level of comprehension of the messages offered by the *EmpathicEditor4Accessibility* tool compared to another accessibility evaluation tool with a classic interface (TAW-CMS) [39]. Three tasks were performed with barriers related to images, links and headings. The results showed the difficulties faced by prosumers in interpreting accessibility errors when displayed in a technical language, and that a more empathic presentation can help toward a better understanding of these problems [36].

To further validate the design and evaluate the communicability of *EmpathicEditor4Accessibility,* we used a method of SemEng, the Semiotic Inspection Method (SIM) [37].This method focuses on analyzing the message delivered by the designer of a system, and evaluates the messages displayed on the *EmpatichEditor4Accessibility* system interface. We did a comparison between *EmpathicEditor4Accessibility* and TAW-CMS, an existing evaluation tool of web accessibility [38]. The results showed that TAW-CMS [39] targets very technical users, with a deep knowledge on accessibility, while *EmpathicEditor4Accessibility* system targets non-technical users with poor or no knowledge on accessibility. The main reason is that *EmpathicEditor4Accessibility* shows messages closer to users without accessibility knowledge like this: "Cesar Cerezo has visual disability. He can't perceive this image because it does not have a description in text". Would you like repair this problem? follow these steps … ". And each barrier has different steps (1, 2, 3…) that explain how to solve the problem related to the WCAG guidelines.

## 5 CONCLUSIONS AND FUTURE WORK

The *EmpathicEditor4Accessibility* system, tries to facilitate empathy with accessibility problems, to foster the creation of accessible content and improving the accessibility user experience [40] [41]. The communication design and the empathy built into the system makes the tool suitable for non-technical audiences with no previous knowledge on web development.

Following the MPIu+a methodology in the development of the system and considering SemEng to create the informative messages has provided a more empathetic tool for communicating issues related to the WCAG guidelines. Furthermore, the evaluations carried out on the system with the prosumer user test and the evaluation of the communicative messages of the system with the Semiotic Inspection Method (SIM), have shown that the approach currently shown by the accessibility evaluation tools may not be adequate for prosumers. In this sense, we believe that the position adopted in *EmpathicEditor4Accessibility* may inaugurate a new generation of web evaluation tools more adapted to new non-technical users.

As a future work we will continue to develop the *EmpathicEditor4Accessibility* system, conducting new assessments with prosumer users in order to improve the comprehension of messages and use of the system. On the other hand, we will adapt the tool as a flexible plugin available on different CMS systems.

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