Facilitas: an accessible video player

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ABSTRACT
Recently, the production and availability of multimedia Web content, as videos, have increased. In this scenario it is important to consider accessibility requirements so any user can whelm the barriers to access content regardless of limitations imposed. One of the main barriers found is to make videos accessible on the Web but few researches have been made on how to overcome those limitations. In this paper we describe a video player, called Facilitas, designed in order to provide the rationale of how some of video related barriers or limitations could be overcome. Facilitas player has new controls different from the ones in other players. We describe a user testing to explain which controls participants frequently use to complete a task. Finally, results are discussed.

1. INTRODUCTION
Recently, the production and availability of multimedia Web content as videos has increased [5]. On the other hand, Web accessibility initiatives are attracting researchers from different fields due to the social inclusion contributions involved and, also, due to the challenges on making the huge amount of Web multimedia content accessible. The W3C (World Wide Web Consortium) standardizes a set of guidelines for designing user agents to help disabled people. Those guidelines are described in User Agent Accessibility Guidelines - UAAG [9, 10]. One problem to include the guidelines in Web content is that the designer needs to choose how it should be implemented considering, for example, the coding language or browser. When multimedia content is included in Web sites, it is important to include assistive methods in the code and the interaction with the users must be considered. Unfortunately, those aspects are not covered by W3C guidelines.

This situation leads to a gap on accessibility research. Moreover, most of the assistive technologies in the Web content concern text, indicating the need for more studies on other media types such as audio and video. Regarding video, some researchers have focused on video player functionalities [3, 4, 6], others on media player for disabled users [1]. Recently, systems handling videos have a strong impact on people's lives (YouTube, Facebook and Netflix, for example), and require special attention on its accessibility capacity.

In this paper, we propose a video player, called Facilitas Player, designed to provide the rationale of how some of those mentioned barriers or limitations could be overcome. We proposed and tested new features, such as tags and search (just to cite some), allowing users to navigate through the video searching in closed caption or audio description. Those new features were designed to be compliant with UAAG guidelines. Moreover, it's worth noticing that there is no research that reduces accessibility barriers to zero [8]. So we argue that we have to design having in mind the accessibility barriers should be minimized and the usability should not be disregarded.

Section 2 discussed related work, while the Facilitas Player is presented in section 3. In section 4, we outline user study tasks that were conducted over the Facilitas Player. Finally, section 5 offers concluding remarks and future works.

2. RELATED WORK
According [4], some basic controls are necessary to obtain an accessible media player: controls that allow users to play or to stop the video, resize the viewports and adjust the volume. The authors also describe some additional controls: controls that allow users to enable or disable subtitles and audio description, search in the caption text, forward or delay seconds within a reproduction, change the size, font or color of the text, help documentation, among others.

Accessibility for media players on the web is discussed in [6], the researchers compared YouTube, BBC iPlayer and CCPlayer, all of them developed with Adobe Flash technology. They are embedded in a web page and allow users to access the content without another application opening. As far as we know, CCPlayer is the most accessible player reported on the literature until Moreno developed a player. CCPlayer offers the user different documents among which describe accessibility features to use on it. It has a menu that explains the keyboard shortcuts and allows searching for any word in the video, but with no support for audio description.

An accessible HTML5 Media Player was developed by [6] to follow the suggestions made by UAAG 2.0. It was made using not only HTML5, but JavaScript and CSS as well. The player has the following controls: play, stop, rewind seconds, forward seconds, volume controller, audio controller, caption on/off, audio description on/off, help guide and select caption language. However, it does not support search functionality.

YouTube is the most popular video search system on the web. YouTube provides some controls that could help accessibility issues, like captions or screen resize. Also, it provides automatic transcription and subtitles. However, subtitles are difficult to operate in some browsers and they are not accessible by the keyboard. Another problem is that the screen reader tools cannot always distinguish accurately the function of controls implemented in Flash and some screen readers cannot access controls at all.

A video player that adjusts the current playback speed was developed by [3]. Our video player has forward and rewind controls. Other researchers [1], collected and analyzed 187 noncommercial videos uploaded to YouTube and coded them in a range of dimensions to characterize the interaction, the challenges encountered, and the adaptations adopted in daily use. They tested them with physically disabled users and showed that while many people with motor impairments find these devices empowering, accessibility issues still exist.

Media repositories, such as YouTube, not only allow users to upload their videos but also encourage them to annotate the videos with descriptive words called tags. Tags provide the description of video content and greatly facilitate the categorization, sharing and search of videos. Researchers affirm even if the tags are provided

for a whole video, they may describe only a small part of the video content [5]. As a result, when searching for video information via tags, users are often bewildered by the vast quantity of seemingly unrelated videos returned through video search engines. The users usually have to painstakingly browse through each video to find the interesting parts.

As can be seen, issues on Web video accessibility still need to be studied. The research found in literature focus in specific guidelines of W3C, emphasizing some functionalities different from traditional. CCPlayer has search, but not audio description. Moreno's player has audio description, but not search. YouTube has automatic transcription and subtitles, but screen readers cannot access its functionalities at all.

3. FACILITAS PLAYER

We have developed an accessible media player, Facilitas Player, using HTML5, JavaScript, jQuery, jQuery UI and CSS3, to provide functionalities to make videos accessible. The attributes are included within <video> tag. The player is made as a jQuery plugin, therefore, by simply calling *$(selector).facilitasplayer(options)* the Facilitas player will load. Since it's a jQuery Plugin, its architecture is based on Implicit Invocation, i.e., after initialized, all controls and listeners are instantiated and the player is ready to receive event notifications from the video tag and/or from toolbar buttons. When an event notification is received, it invokes all procedures registered for that event. For instance, take the time change event. Every a certain amount of milliseconds, the video sends a notification announcing that the time has changed. The player then receives the notification and updates its interface, rounding the milliseconds to seconds and displaying to the user the elapsed time of the video. The link for the Facilitas Player is http://5.135.182.74:8080/.

The current controls include basic controls as play/pause, rewind, forward, volume controller and full screen; and new controls, such as caption, search, tags, settings panel (include text style configuration) and light. Some functionalities of accessibility also include highlight and keyboard access.

Table 1. Video Player Controls

Controls	JW Player	YouTube	BBC iPlayer	CCPlayer	Media Player [6]	Facilitas Player
Alternative content	Yes	Yes	Yes	Yes	Yes	Yes
Highlighting	Yes	Yes	Yes	Yes	Yes	Yes
Text configuration	-	-	-	-	-	Yes
Volume configuration	Yes	Yes	Yes	Yes	Yes	Yes
Orientation in Viewports	Yes	Yes	Yes	Yes	Yes	Yes
Keyboard access	Yes	Yes	Yes	Yes	Yes	Yes
Search	-	-	-	Yes	-	Yes
List with search result	-	-	-	-	-	Yes
Preference settings	-	Yes	Yes	Yes	Yes	Yes
Toolbar configuration	-	-	-	-	-	Yes
Light	-	-	-	-	-	Yes
Tags	-	-	-	-	-	Yes

Some type of the accessibility features of current media players conform to the UAAG are: G1.1: Alternative content, G1.3: Highlighting, G1.4: Text configuration, G1.5: Volume configuration, G1.8: Orientation in Viewports, G2.1: Keyboard access, G2.4: Search, G2.7: Preference settings and G2.8: Toolbar configuration. Based on the discussion in Section 2, we compared, the characteristics of players (Table 1).

Four of those functionalities are present only on Facilitas player: list with search result, toolbar configuration, light and tags. These are explained below.

Tag control allows the developer to add links to the video to divide it into parts. Each tag is linked to a specific time in the video. Tags provide a short description of the video content and a long description when it is selected, facilitating the search of videos. For instance, in Figure 1, the video has six tags. If we select "Tip:dark chocolate" tag, the video skips to the third tag time and a long description appear.

Figure 1. Facilitas Search Control and Tag Control.

The search control allows the search of a word or phrase that appears in the subtitle text. The player will show all results and when a result is selected, it skips to that point on the video. For instance, in Figure 1, we searched for the word “butter”, returning a set of two results. When a result is clicked, the player skips to that position.

Figure 2. Facilitas Text configuration.

Another functionality of Facilitas Player is the settings panel which allows text configuration to change style, color and size in real time (Figure 2). There is a control for configuring toolbar position that is still in development. It's set to bottom, by default. Finally, a light functionality is represented as a lamp icon on the video (Figure 2). This functionality fill with black color all content around the video and align it to the middle of the page.

4. USER TESTING

In the context of usability evaluation, we have a set of 10 heuristics proposed by Nielsen [7]. In fact, the heuristics guide experts to test a user interface. Including accessibility, can be affected both usability principles flexibility and efficiency of use (#7) and aesthetic and minimalist design (#8). Therefore it is important to perform a user test with real and common users, so the other usability principles will not be damaged. We performed an experiment to know the important functionalities on videos and those the participants chose to complete some tasks.

In the experiment, participants were provided with 5 videos using Google Chrome browser. They were instructed to choose two of them. They completed a series of tasks in which they had to answer three questions for each video. The first two tasks were questions about the video content. Third task was about caption configuration. For each video content, they had to show the scene on video where the question's answer was located.

At the start of each participant test, we explained the test method. Then, the participant chose the first video they would like to watch. Two questions about the video content were asked, and they answered the question and found the scene on the video. To find the scene, they used some controls: search control, tag control, rewind/forward controls or time bar. One question about caption configuration was asked, and they used settings panel to answer it.

For the testing, we used five videos with subtitles in Portuguese. Two of them had audio in English and three in Portuguese. For each video, we created between 2 and 7 tags (mean 5). The time of all videos is between 4 and 10 minutes (mean 6). We used Morae software[1] to facilitate the research process and data analysis.

Ten people, six of them university students, participated in the experiment. Their age ranged from 23 to 63 years old (40% were 23 to 24 years old, 30% were 25 to 27, 10% were 32, and 20% were 59 to 63). Four participants were female. The experiment took approximately 30 minutes to complete by participant. The participants chose two videos based on their preferences. For their video selection, 35% of participants chose a cooking video, 30% chose a documentary video, 20% chose a TV show, 10% chose a terror movie, and 5% chose a comedy movie. Participant 7 has a mild hearing impairment and didn't use hearing aid, three of the users (P1, P2 and P4) without disabilities had myopia and wore glasses (that did not affect the interaction) and the others had no disability.

4.1 Results

We analyzed the average time to complete a task for each participant. Tasks are labeled by a letter (P=participant, V=video, T=task) with a number (participants number).

Tasks represent the type of video a participant chose. Red color (P1V1, P3V1, P6V1, P10V2) represents comedy TV show; purple (P1V2) represents a comedy movie; blue represents (P2V1, P3V2, P4V2, P5V2, P8V2, P9V1, P10V1) a cooking video; yellow (P2V2, P4V1, P5V1, P7V2, P8V1, P9V2) represents a documentary; and orange (P6V2, P7V1) represents a terror movie.

Tasks P1V1T2 (251 seconds), P2V1T1 (163 seconds) required more time than the other tasks, because in P1V1T2 the participant searched eight times with words that did not return the expected result, then he used progress bar to complete the task. P2 also said that she did not pay attention to the video because she was distracted using the video player controls. In P2V1T1 task, she used four tags and one search with an unsuccessful result, then she used time bar to complete the task. After finding the answer, she tested the search control using one word of subtitle and checked if the search result was correct.

In the second video, P1 spent less time than the first video that he watched. He paid attention, answered the question about content video (P1V2T1) using his memory. In P1V2T2 task he used one tag.

Task 2 in the terror movie (P6V2 and P7V1) required more time than task 1, independently of the participant age (P6, 25 and P7, 59). Both P6V2T1 and P7V1T1 used the progress bar twice to complete the task. P6V2T2 and P7V1T2 used search three times to complete the task. In P7V1T2 task, the participant wasted her time on misspelled words.

Two participants (P3 and P10) are women and chose comedy TV show. The first task took longer than the second one. In P3V1T1 task, the participant used two tags and one search to complete the task. In P10V2T1 task, she used the same word of P3 to search. In both P3V1T2 and P10V2T2 tasks, the participant used one search to complete the task.

70% of participants (P1, P2, P3, P5, P7, P8 and P10) spent more time on tasks for the first video than for the second video, in other words, the participants learning controls functionalities independently of the type of video. For example, P2 chose cooking as her first video and documentary video as her second video, while P6 and P8 chose videos in the reverse order.

To know what controls the participants used during a task, we analyzed each video and counted how many times participants used each control until the task was completed. During a task, the search control was used 53,6%, time bar 30,9%, tags 13,4% and forward 2.1%. We also counted how many times the participants used each control to complete the task. For example, in V1T1, 6 tasks were completed using search control. The search control was used 62,5% to complete a task, time bar 30%, forward 5% and tags 2,5%.

In both cases, we can see that the search control was the most useful control, followed by progress bar control. Although participants used Tags during the tasks, only one task was completed using Tags. For the forward control, the result was maintained. P1 after watched V1 said "one different thing was the tags marked, I never saw it before, but I was watching to see how they worked". After watching V2, he said "Adding tags would be a good option. I want to rename the first tag". P3 said that at the beginning, she did not understand, because it was marked in the progress bar. P9 said that tags mean keywords, as in YouTube, and for these reason, he did not use. All participants, except P1 and P3, suggested that they could have had the option to add some tags to the videos. P4 and P5 suggested deleting some tags.

We analyzed the cooking video using Boxplot (See Figure 3a). For task 1, there is an outlier with 163,95 seconds as value. Analyzing the participant interaction for this outlier, she used some controls to complete the task: tags 4 times, search 1 time and progress bar 1 time. Participants spent 27,47 seconds on average to complete task 1 and 26,77 seconds to complete task 2. The times in both tasks, 1

[1] Morae software - http://www.techsmith.com/morae.html

and 2, are similar. There are no outliers for documentary video (see Figure 3b). The participants spent 34,44 seconds on average to complete task 1 and 50,96 seconds to complete task 2.

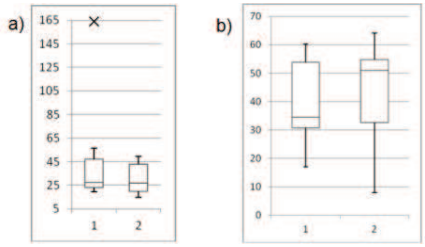

Figure 3. a) Cooking video boxplot, b) Documentary video Boxplot

Regarding the caption configuration task, we asked the participants to perform one task for video 1 and another for video 2. Three types of tasks were created: change font style to Verdana, change font color to yellow, and change font size to 20.

Four Participants (P2, P5, P7, P8 and P10) had difficulties in changing the subtitle color because in the configuration window there is a point to select color and by default this point is in the upper left corner. In all cases, that point was unobserved by these participants. P2, P5 and P10 have computing skills, but P7 and P8 not. When P7 learned how to change color, he/she began to test changing subtitle colors. A characteristic of panel settings is to change style, color and size automatically without clicking on button. P5 liked the color change characteristic and P10 said that the change size characteristic is really important. In fact, this issue is the one directly related to usability principle number 8 mentioned by the users.

5. CONCLUSIONS AND FUTURE WORK

While researchers have developed usual video players, we developed and tested an accessible player, Facilitas, following guidelines of UAAG of W3C: alternative content (Guideline 1.1), text configuration (Guideline 1.4), volume configuration (Guideline 1.5), support to full keyboard access (Guideline 2.1), and text search (Guideline 2.4).

We tested with real users and the experiment showed important results about new controls, tags and search. Tag control did not used frequently in the test cases, probably because it was different from other functionalities and participants never saw it before. During user test, we detected that exists a misunderstanding between tags and keywords, therefore we propose to change the name “tag” to “link”, because is a link into the video and add a phrase “Go to:” before the tags to improve the user experience.

On the other hand, search control turned to be a very useful control, as it was used in 62,5% of the cases to successfully complete a task. This functionality was more intuitive than the tags. At the end of the user test, we confirmed Petrie's conclusion [8]: the design regarding the accessibility issues promotes better usability.

As future work, we propose to add some functionalities to the Facilitas Player: documentation, language, on hover, preference settings and annotations. Also, we will test with people with older people to know what functionalities of video player are common for them.

6. ACKNOWLEDGMENTS

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