Inaccessible Accessibility Game?! Redesigning the eMAGs digital accessibility game

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ABSTRACT

Learning web accessibility is imperative for people that create web content. eMAG's Digital Accessibility Game is an effort of Brazilian electronic government to create an enjoyable experience by learning accessibility guidelines and best practices. However, the current printable paper version of eMAG's game is not accessible per se. This paper presents the development an accessible web version of eMAG's game, reporting support and validation tools, accessibility checking techniques and guidelines, gameplay adaptations for digital media, and improvements.

Keywords: accessibility, eMAG, game redesign.

1 INTRODUCTION

With the expansion of the Internet access, many important changes occurred in our daily lives. Currently, a big portion of our activities is done or is partially done through Internet. In this direction, there is a deep interest in providing accessible web content to everybody, including people with disabilities that affect the use of computer devices (including smartphones, tablets, etc.), illiterate people, elderly people, and others. Web Content Accessibility Guidelines 2.0 (WCAG 2.0)[16] and the Electronic Government Accessibility Model (eMAG)[8] are important milestones for stimulating creation of accessible content.

The eMAG, purposed by the Brazilian government, has as goal "to be the guide on the development and adaption of the federals government digital content, guaranteeing access to everyone"[8]. It consists of a group of accessibility recommendations to be considered in development process of Brazilian government sites. As part of knowledge propagation policies, the eMAG site provides a board game to teach concepts and principles of the digital accessibility in a simple, funny way. Jogo da Acessibilidade Digital - Digital Accessibility Game[9] - is licensed by Creative Commons (CC BY-NY-SA) and at this moment it has just a physical version. In order to play, we need to print the paper version of board, cards, dice and characters. This is an inconvenient for anyone and it's not accessible to a wide range of players: people with disabilities.

This paper aims to describe the process and the activities related to development of the eMAG's game digital version, according to web accessibility guidelines and allowing anyone to play and learn in an entertaining way the concepts of web accessibility promoted by the Brazilian government. The game was developed using HTML5, CSS and JavaScript technologies which do not need any browser plug-ins to manage player events and media files (image and sound). These technologies also grants compatibility with mobile platform, enabling the access to the game on computers, smartphones and tablets.

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In second section, it is presented a general outlook of accessibility for games. Section 3 describes the eMAG's original game. Section 4 points out the main tools and methods used on this study. In section 5, we present design adaptions, integration of accessibility and validation on the digital version of eMAG's game. Section 6 has our final considerations and clues for future work.

2 GAMES AND ACCESSIBILITY

Digital games are available in a lot of devices and environments in our daily life. Brazil has approximately 50 million players that spread their play time among computers, dedicated consoles, mobile devices and social media[10]. USA has 63% of households with, at least, one person playing regularly[3].

Considering motivational, emotional, social and cognitive benefits of playing digital games[5][4][11], we can highlight that the use of games on education allows to improve the engagement of the student, to stimulate learning processes, and to reinforce concepts by means of a playful experience.

However, a meaningful portion of the population cannot enjoy the benefits of (educational or not) digital games because they have some limitation that makes harder to play or even do not allows playing, since players must to be able to perform many tasks while playing. These tasks can include, e.g., to control a character by pressing buttons, to communicate through text with another player, to point and click on screen elements, to listen to dialogs between characters, to shake the body on the rhythm of a song, etc. When a game is designed having in thoughts just players with perfect physical, sensory and mental development, it is likely that players with disabilities are going to have difficulties to play.

Although there are game accessibility guidelines to make digital games suitable for people with disabilities[1], these recommendations are rarely implemented in games. Game developers and their managers perceive as unprofitable the effort to create an accessible game from the beginning - it's too hard, it's not cheap, and it favours only a few people. It leads to a reactive stance: when demand for accessibility appears, we put it in the game.

Implementing changes in a full developed system is harder. The rework throughout the entire software process becomes really costly since slight changes in requirements cause significant modifications in design and even deeper modifications in code[12]. Moreover, addressing accessibility issues during design phases "decreases the time and money to design accessible products and increases the positive impact that accessibility can have on design overall"[6].

3 ORIGINAL GAME DESIGN

The eMAG's Digital Accessibility Game aims to promote the knowledge about web accessibility, showing a wide range of recommendations about improvements and corrections needed in order to guarantee web accessibility. Currently, the game is available on eMAG's website and we can only play it by printing its content.

The eMAG's Digital Accessibility Game is a board game (see Figure 1) where players must travel through spaces in an open circuit, fulfilling challenges presented at some spaces around the board. The first player to complete the circuit wins. For each space

on the board it's assigned an accessibility recommendation or transgression or a special event. In every match, the movement of pawns on the board is appointed by rolling a dice. The number of players per game can range from two to four players.

Figure 1: Original version of the game board.

Spaces with white background on the circuit are, in most of time, related to good or bad web accessibility practices according eMAG[8], benefiting or penalizing players during the match. Some of these spaces lead the player to the next blue backgrounded "Pausa para o caf" (break to coffee) space.

When a player reaches a yellow backgrounded space CRAPTCHA[1], he or she must draw a CRAPTCHA card and solve an accessibility question in order to leave that space. If the question is not answered correctly, the player must stand still on that space and, in the next round, draws another CRAPTCHA card to solve. Figure 2 shows some examples of CRAPTCHA cards and player pawns. "Codificando" (Coding) spaces in the circuit do nothing.

Figure 2: Original player pawns (above) and original CRAPTCHA cards (below).

4 METHODS AND TOOLS

The redesign process of eMAG's game involved analysis of similar products and brainstorming of ideas for the digital version, prototyping and specification of critical requirements. Later, an iterative, incremental process of software development, suchlike Scrum[13],

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[1]CRAPTCHA is a pun with the acronym CAPTCHA, or Completely Automated Public Turing test to tell Computers and Humans Apart. CAPTCHA is a common technique to verify if the user of a website is human and it's largely inaccessible method.

was applied by the development team. Verification and evaluation activities (especially those related to the accessibility assurance) were done simultaneously with development. Each one of these activities are described in details hereafter.

Detailed analysis of eMAG's accessibility game operation involved identifying how the circuit and CRAPTCHA cards work. For this, three members of the research's group engaged on playing the original game and analyzing in a critical way its elements and mechanics. Four games that could inspire the game's redesign of eMAG were chosen: Monopoly Millionaires[2], Barney Chase[3], Monopoly Classic[4] and the Mario Party franchise[5]. The analysis of these games allowed to identify features of similar games that could be implement on the digital version of eMAG's game in a mixed technique of bechmarking and competitive analysis[7].

To complete the requirement's elicitation process, team members and four more guests (people interested in digital accessibility) produced a brainstorming, which consists in a reunion to elucidated ideas to solve a problem and have a better understating about it[2][7], with the object of evoke potential of improvements related to the original version of the game.

Improvements and new features identified on the process of competitive analysis and brainstorming had their viability evaluated regarding the technologies used in the development of digital version of the game (HTML5, CSS and JavaScript) and the Web Content Accessibility Guidelines 2.0[16]. Elements and mechanics of the new game version were consolidated in a paper prototype[15] for making the evaluation. Evidently, the evaluation of accessibility resources on prototype have the same limitations on the original game and they were checked just on the digital version in development.

For the features specification, we have used user stories[7]. The stories were written by the development team itself and they were prioritized by the project advisor. According to the practices used on Scrum[13], stories were organized in a product backlog available at an online kanban chart on Trello[6] detailing and categorizing tasks in to do, work in progress and done to each developer, increasing process visibility to entire team.

During development stage, it was used an iterative, incremental software process based on Scrum[13]. The development sprints varied from one to two weeks, according to complexity of the tasks. After each sprint, a retrospective meeting was done with the entire team. In this meeting, it was presented integrated features and improvements and the next stories were chosen by each team member.
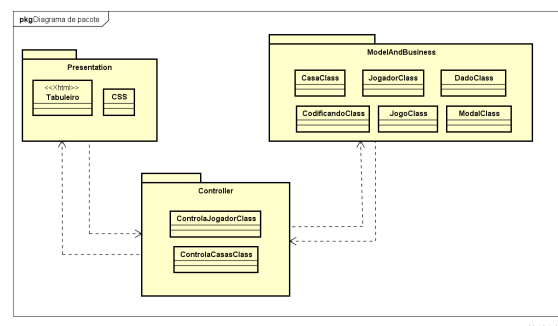

Figure 3: Package diagram of the game in a 3-tier architecture.

NetBeans IDE was used as the development platform for the dig-

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[2]Available at https://pt-br.facebook.com/monopolymillionaires/

[3]Available at http://mrjogos.uol.com.br/jogo/barney-chase.jsp

[4]Available at http://www.pogo.com/games/monopolyclassic

[5]Details available at http://www.mariowiki.com/Mario_Party_(series)

[6]Available at http://www.trello.com

ital version of the game. The eMAG's game digital version was developed using HTML5, CSS and JavaScript languages. jQuery library[7], that adds interactive and dynamism to the web pages[14], was used just to make easier JavaScript elements' handling. jQuery widgets were not incorporated in the game because they have proven widely inaccessible in previous researches. A BitBucket repository with GIT control version was created to maintain the source code and other software artifacts (like prototypes, architectural diagrams, class diagrams). The 3-tier architecture UML package diagram is showed in Figure 3. For image edition we were used Gimp, Paint.net and Graphics Gale image editors.

The game was developed according to Web Content Accessibility Guidelines 2.0 (WCAG 2.0)[16] and with the recommendations of the Electronic Government Accessibility Model (eMAG)[8] in mind. After integrating the new features, manual checklist inspection [2] was applied using success criteria of conformance level A from WCAG 2.0 and the eMAG accessibility recommendations as verification items. Additionally, automatic validators AccessMonitor[8] (with WCAG 2.0 evaluation option) and AccessColor[9] were used as double check.

5 GAME REDESIGN

During the development of digital version of the game, improvements were pointed in comparison to the original game about its playability and interaction with the player besides accessibility brand new features. The new (under development) version of the board game is showed in Figure 4.
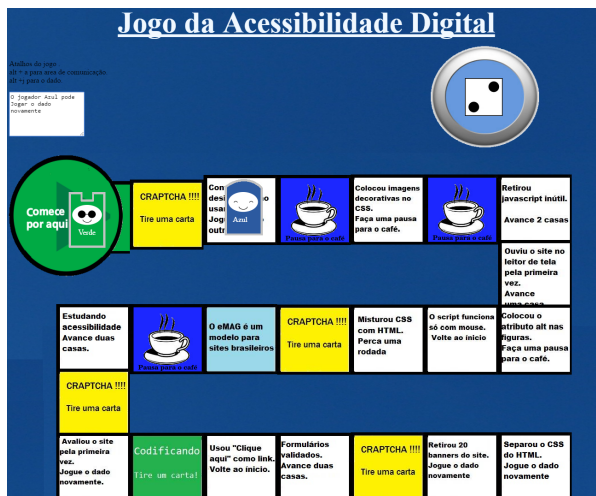

Figure 4: Preliminary digital version of eMAG game.

On the original version of the game, CRAPTCHA cards have challenges about accessibility that are not educational or are inaccessible by definition. CRAPTCHA cards present questions without alternatives that can be chosen. If a player draws a CRAPTCHA card which nobody knows the correct answer, that player could lie about knowing the answer and advance in the circuit. Even for honest players, facing CRAPTCHA questions whose nobody knows the answer force the game to stop to allow the players find out the solution. Other CRAPTCHA cards simply presents some image and ask to the player describe it - an impossible task for a blind player in both paper and digital versions. Based on those aspects, the new

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[7] Available at https://jquery.com/

[8] Available at http://www.acessibilidade.gov.pt/accessmonitor/

[9] Available at http://www.accesskeys.org/tools/color-contrast.html

CRAPTCHA questions were reformulated to multiple choice questions. If the player selects the correct answer, he or she can roll the dice. If the wrong answer is chosen, the same question is showed to the player on the next round without the previous wrong chosen answers.

Codifying spaces have now a meaning on digital version: once a player stops his or her pawn on a Codifying space, he or she draws a Chance card. Those cards bring good or bad luck events to players related to good and bad accessibility practices: good luck cards may make player advance some spaces, change places with some player ahead, roll the dice again, etc.; bad luck cards may make the player back some spaces, tow an opponent while advances, etc.

An available, always visible text area aims to inform players about the last event that happen, being particularly useful to screen reader software[10] users. A hidden event history that shows details about the whole gameplay session was also integrated on the game, allowing blind players to better understand the sequence of the events by activating a keyboard shortcut. Spaces on the circuit have been also labeled with a number on their alternative texts that can be accessed by a screen reader.

To comply additional accessibility guidelines and offer more flexibility to players, keyboard shortcuts were added on the main actions and menu elements, e.g, dice roll and text area where the last event on the board is described.

5.1 Verification and Validation

Verification process has included manual and automated inspection and validation process has involved user testing.

Manual inspection was conducted before the integration of every feature thought checklists by analysing the resulting HTML code of the feature. WCAG 2.0[16] level A conformance success criteria and eMAG[8] recommendations form the checklist items. Some success criteria and recommendations present challenges during development as ensuring meaningful navigation sequence and coherent focus though keyboard, avoid opening pop-ups and other interaction instances, and creating appropriate descriptive texts for image alt attribute and widgets.

Automatic accessibility inspection include send HTML sources to AccessMonitor and AccessColor tools, and this process was done at the end of development sprints. In AccessMonitor first verification, the two main screens of the game reach 6.1 (from a max 10) and 5.4 (from a max 10) points. The problems found are related to using JavaScript in non-interactive elements, duplicated id on elements, usage of form elements without a "submit option" and title text, and XHTML syntax (false positive) errors. AccessColor tool didn't found any contrast problems.

Besides our best efforts, automated inspection catches accessibility problems caused by inexperience of development team in create accessible web content and inspect code through guidelines.

Testing with a blind user was also done. We have used think aloud communication protocol[2] and we have followed a formal protocol with some common game tasks (e.g., start a new game, choose a pawn, roll the dice, figure out the last three game events). In a 20 minute game session, the user has indicated some accessibility issues not covered by accessibility guidelines:

- "The game miss the context and the rules. They should be available while playing by some shortcut." (not implemented yet)

- "It could contain some kind of 'game general status' that summarizes the entire board from the perspective of my pawn. It's very slow to follow the entire circuit to figure out where are

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[10] Assistive Technology software used mainly by blind people that reads plain-text content or text information under screen elements.

my opponents." (implemented temporarily by events history, under validation)

- "You should improve some alt texts: 'begin here' is an a space on the board that I don't understand very well." (under correction)

- "The spaces could be numbered. It should be easier to know how far I'm from the finish." (implemented)

5.2 New Aesthetics

The current digital version of the game in addition to be under correction is receiving new aesthetics from a 16-bits perspective.

The original pawns (Figure 2) will be changed by new more representative human and animal pawns (Figure 5) in a pixel art style allowing the players choose those with whom they most identify. Specific sound effects and interactions between pawnson the same space should increase immersion and improve user experience.
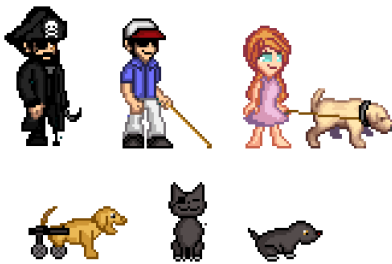

Figure 5: New representative pawns.

The long sentences in original spaces of the circuit should be also changed by icons (Figure 6). The text of the events will be showed inside a modal box and added to events history.

Figure 6: Old and new spaces of the circuit.

6 FINAL CONSIDERATIONS

Accessibility is a quality criterion in software development and it benefits a substantial portion of the population. From traditional web sites to mainstream games, accessibility allows people with disabilities to practice their citizenship and enjoy the immersive world of digital games. The eMAG's Digital Accessibility Game aims to help web developers to learn accessibility recommendations from eMAG in a pleasurable way. However, the current version of the game is available only on paper, making impossible to be played by some people with disabilities.

Creating a digital version of the game using web technologies (HTML5, CSS and JavaScript) ensures it can be played in a wide range of devices, allows it can be accessed easily over Internet, and favours the accessibility assurance by using mature guidelines to develop accessible web content (the game).

The current version of the game digital version includes the main features of the original game (two player game over the circuit, good and bad luck events and CRAPTCHA cards) at similar aesthetics. Accessibility components that assure the minimum level of conformance with accessibility guidelines allow people with disabilities (especially blind people and people with limited mobility) to play the game, although play experience is not optimized.

Automated inspections and user testing with a blind subject have disclosed some critical accessibility problems not found by manual inspection. Testing with users with different disabilities and continuous inspection are needed to ensure quality to every player profile.

It's under development the integration of new aesthetics and new features that improve gameplay experience for people with disabilities, e.g., sign language videos, sound options, random generated circuits, interactions between the players pawn, etc.

REFERENCES

[1] J. Cheiran. Diretrizes de acessibilidade para jogos. Avaliable: http://inf.ufrgs.br/ jfpcheiran/diretrizes/ Access: June 2016, 2013.

[2] W. Cybis, A. Betiol, and R. Faust. *Ergonomia e Usabilidade: conhecimento, metodos e aplicacoes, 2010.* Novatec, Sao Paulo, 2010.

[3] ESA. Essencial facts about the computer and video game industry 2016. Avaliable: http://www.theesa.com/wp-content/uploads/2016/04/Essential-Facts-2016.pdf Access: June 2016, 2016.

[4] R. Golcalves and R. Thiry. Development of a game to support the teaching of requirements engineering: The requirements island. In *Proceedings of IX SBGames*, pages 358–361, 2010.

[5] I. Granic, A. Lobel, and R. Engels. The benefits of playing video games. *American Psychologist*, 69(1), 2014.

[6] S. Henry. *Just Ask: Integrating Accessibility Throughout Design*. Lulu.com, s.n, 2007.

[7] IIBA. *Um guia para o corpo de conhecimento de analise de negocios(BABOK Guide)*. International Institute of Business Analysis, 2011.

[8] MPOG. emag - modelo de acessibilidade em governo eletronico. Avaliable: http://emag.governoeletronico.gov.br Access: June 2016, 2013.

[9] MPOG. Jogo da acessibilidade digital. Avaliable: http://www.governoeletronico.gov.br/acoes-e-projetos/e-MAG/jogo-da-acessibilidade-digital Access: June 2016, s.d.

[10] P. Penix-Tadsen. *Cultural code: video games and latin america*. MIT Press, Cambridge, 2016.

[11] J. Praseres. Educacao e jogos eletronicos: Estudo de caso dos games produzidos com financiamento da finep. In *Proceedings of IX SBGames*, pages 77–86, 2010.

[12] R. Pressman and B. Maxim. *Software Engineering: A practitioner's approach*. McGraw Hill, New York, 8 edition, 2014.

[13] Scrumstudy. *Conhecimento em Scrum (Guia SBOK)*. VMEdu, Phoenix, 2016.

[14] M. Silva. *Jquery: A Biblioteca do Programador Javascript*. s.n, Sao Paulo, 2 edition, 2010.

[15] C. Snyder. *Paper prototyping: The fast and easy way to design and refine user interfaces*. Morgan Kaufmann, San Francisco, 2003.

[16] W3C. Web content accessibility guidelines (wcag) 2.0. Avaliable: http://www.w3.org/TR/WCAG20 Access: June 2016, 2008.