The Gamification of Accessibility Design

A Proposed Framework

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***Abstract*— The use of Gamification for the purpose of training and raising awareness has attracted considerable interest over the last years. However, the development of such solutions to use within the area of accessibility design has not been yet explored. In this paper, we present a proposed framework using Gamification as a method for engaging and motivating web designers to increase the adoption of the W3C WCAG 2.0 guidelines. It is anticipated that our framework will provide a more interactive and intuitive learning experience.**

Keywords—Gamification; Games; WCAG; Accessibility; Design; W3C; Inclusion; Word Wide Web; Serious games

I. INTRODUCTION

The development of accessible applications, services, goods, or infrastructures is amongst the key considerations laid out in the European Disability Strategy for 2010-2020 [1]. Recent findings indicate that 70 million people aged 15 and over reported a disability in the EU-27 [2], which may prevent them from fully participating in social activities and access to online services. According to the UK Office for National Statistics, 25% of disabled adults had never used the Internet in 2016 compared to 11% of non-disabled adults [3]. This is an important disparity, especially in an age where not having access to the Internet is a huge disadvantage. Furthermore, these numbers are predicted to rise as the EU's population ages.

Limited access to the Internet for disabled adults is typically accounted to the lack of support for many of their accessibility problems. While numerous efforts have been noted in the past, only 5% of public websites comply fully with web accessibility standards on average in the EU-27 [4]. In fact, a survey of 1,000 UK Web sites identified that only 19% of the web pages complied with Web Content Accessibility Guidelines (WCAG) [5][6]. This low percentage of compliance implies that the number of web designers that follow established guidelines is not sufficient. While by law in the UK [7] service providers are required to make their websites accessible, there seems to be a general lack of awareness of the available resources, as well as limited training and motivation for web designers in accessibility design. Additionally, the EU market for assistive devices is still largely fragmented, and the devices themselves are generally expensive [4].

As a result, current practices and efforts do not fully reflect the needs of people with disabilities. It is therefore critical that web designers understand the importance of integrating such resources and practices into their designs. This in turn can prove to be beneficial for all involved parties, as accessible products are 35% more usable by everyone and are typically cheaper to run and maintain [8][9].

In response to the need to identify better means to motivate users and improve user experience, Gamification has quickly become an established practice. Gamification is typically defined as the use of game design elements (e.g. badges, leaderboards, etc.) in non-game contexts [10]. The motivation behind leveraging Gamification is typically related to improving education and training, employee engagement, and motivation and wellness, to name but just a few examples. As a result, the Gamification industry is estimated to grow to over $11 billion by 2020 [11].

However, to the best of the authors' knowledge, the use of Gamification to raise awareness and train web designers in following the available web accessibility guidelines has not been yet explored. Past research revealed that the use of such innovative solutions towards assisting designers in this area was well accepted [12], but also identified that the lack of familiarity, and in some cases, the lack of technical knowledge was one of the major challenges [13]. To address this issue, in the current paper we propose a gamified solution that allows web designers to learn about established guidelines in a fun and interactive manner, with an overall aim to train them and raise awareness of their importance in web design.

II. RELATED WORK

A. Accessibility Design

A range of inclusive design practices has been used by practitioners to address the different accessibility problems over the past years. In an effort to empathise and understand the needs of a particular audience, the author in [14] proposed the use of personas i.e. the creation of fictional characters to represent disabled user groups. Extending this notion, the authors in [15] took a more practical approach by directly involving disabled users in the design and evaluation of new living spaces via a virtual environment named HabiTest. On the other end of the spectrum, a number of efforts focused on assisting designers with no direct user involvement by using automated tools, which evaluate designs against set guidelines automatically [12]. However, automated checking tools may not be in sync with the latest guidelines and may be limited to assessing a particular type of product or component, while using available guidelines may be too restrictive, overly complex, and may sometimes require interpretation by a designer, which leads to errors in conformity [16][17]. Indeed,

further research has indicated that those guidelines are often complex and ambiguous [18][19].

There is little, if any, previous research on improving the complex and laborious task of following such established guidelines. Most work on accessibility design has focused on providing tools and methods that incorporate those guidelines; however, those strategies and practices do not address motivation and lack of awareness issues that designers currently seem to be faced with.

B. Gamification

The investigation of the benefits of game elements in engaging people in a work environment is not new. Research by [20] has shown that game elements such as leaderboards and feedback mechanisms help people feel more ownership and more engaged when carrying out tasks. Past work demonstrated that motivation was indeed improved when game elements were introduced in work-related activities [21]. User motivation is typically understood by means of the self-determination theory (SDT) [22], according to which human beings can be intrinsically (based on wants and needs) or extrinsically (based on rewards) motivated when carrying out a task. Research has shown that intrinsic motivation is the most effective [23], as it's supported by three core psychological needs – competence, autonomy, and relatedness, which when fulfilled help users feel more motivated.

There are several examples of the above theory in practice. Duolingo used gameful design elements to help people effectively learn a new language [24]. Similarly, Microsoft [25] used Gamification to improve the translation for its Windows OS with over 900 employees completing 26,000 tasks, while [26] demonstrated that users learning via a gamified tutorial finished tasks 135% faster than a control group. Finally, [27] found that the use of game mechanics helped increase participation in an online training by 61%. Work by [28] identified that there is a limit to how close a task in such environments should be to the real-world scenario. A greater abstraction level between the real-world scenario and the game scenario would increase the enjoyment level, yet it would also potentially increase the difficulty for achieving the original goal of the training. Alternatively, the closer the real-world and the game-world are, the easier it would be to achieve the training goal, but this comes at the cost of user enjoyment and therefore engagement. In evaluating the effectiveness of such efforts, Harpur and De Villiers [29] proposed a set of criteria that are typically used to evaluate learning environments, which comprise dimensions of User Experience (UX) and education usability.

Accordingly, in our work, we extend this notion by providing a framework that clearly maps real-world elements of the task under study to elements of games for improving awareness and increasing adoption of available web accessibility guidelines.

III. PROPOSED DESIGN FRAMEWORK

A. Mapping between WCAG core tasks and game mechanics

Gamification requires that we identify tasks that are the basis of a gamified solution. WCAG 2.0 [7] is a set of guidelines that were published by the World Wide Web Consortium (W3C) for the purpose of providing web designers a means for making web content more accessible for users with different types of disabilities. WCAG 2.0 involves four principles, which consist of 12 guidelines. The 12 guidelines provide the basic goals that web designers should work toward. For the purposes of this work, each guideline is considered a core task that must be accomplished. Fig. 1 graphically depicts how the 12 identified core tasks can be mapped to game mechanics typically used in many games.

The proposed framework aims to implement game mechanics in the context of web design, so that users can make the connection between the real-world and the game-world whilst immersing in the gameplay. The game consists of multiple levels, each mapping to one of the WCAG guidelines. The aim is to utilise different mechanics in each level so that the user feels both challenged and motivated to discover new mechanics, whilst learning the guidelines. The users have a helper named 'Assistive Robot' shadowing them as they move through the levels. The Assistive Robot acts as a reference to Assistive Technologies and in various levels it will act as a guide or the motivation of the mechanics to help the player understand the role of assistive technologies in their design.

The proposed mapping between WCAG and the game mechanics is as follows:

1) Perceivable

The Perceivable principle states that information and user interface components must be presentable to users in ways they can perceive. This principle consists of four guidelines which have been mapped to specific game mechanics:

- *Text Alternatives*: All non-text content that is presented to users should have a text alternative. This guideline has been mapped to a 'Mystery Box' mechanic, where users are in a dark room viewing an unclear picture. The Assistive Robot will explain what is on the image and the player must write the description in the 'ALT tag' of the image to progress.
- *Time-based Media*: Provide alternatives for time-based media, such as Audio/Video content. The corresponding mechanic to this guideline is a 'Mystery Box', where an unclear video is being played in a noisy room. The Assistive Robot will communicate with text and the player needs to fill the 'ALT tag' to receive the video's message to unlock the door to the next level.
- *Adaptable*: Create content that can be presented in different ways (for example simpler layout) without losing information or structure. The corresponding mechanic is a 'Keys and Doors' mechanic, where Keys are content such as text, pictures, videos, etc. Doors are a mobile/PC platform, etc. Players should fit the content into the platform provided. If the platform is out of reach, then the player can access it with the help of the Assistive Robot.

- *Distinguishable*: Make it easier for users to see and hear content including separating foreground from background. 'Tactical Assassination' is the mechanic mapped to this guideline. The player needs to find a specific target in the crowd. Everyone is the same colour, hence the Assistive Robot will help to apply filters to make the target visible. Another alternative is that the music is too loud and the player cannot hear, except by adjusting the settings.

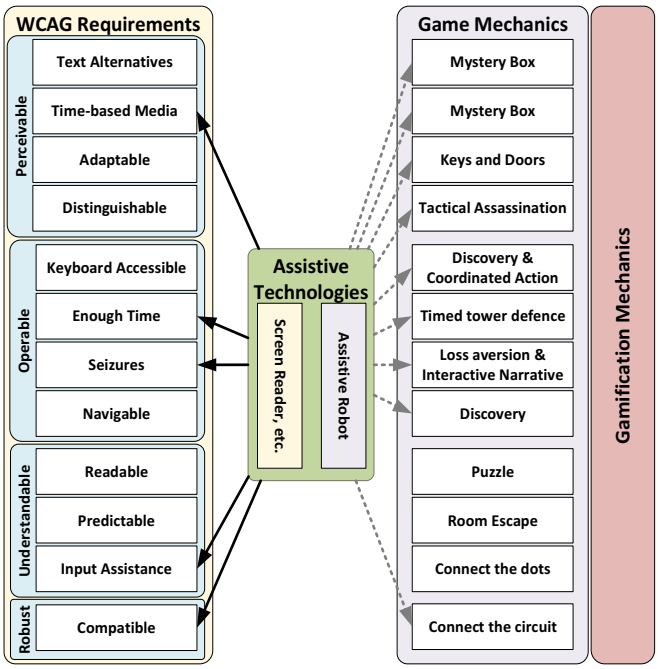

Fig. 1. Framework suggesting mechanics mapped to guidelines.

2) Operable

This category consists of four guidelines and it states that user interface components and navigation must be operable.

- *Keyboard Accessible*: Make all functionality available from a keyboard. This guideline is mapped to 'Discovery and Coordinated Action' mechanics, where the player would need to fix a keyboard to type in the password by finding the missing keys. The Assistive Robot suggests shortcuts. There are no-keyboard zones and no-mouse zones, which the player would need to overcome.

- *Enough Time*: Provide users enough time to read and use content. This has been mapped to 'Timed Tower Defence' mechanics. The player has to destroy 100 enemies in the time given. Players cannot win until the Assistive Robot helps them increase the time limit.

- *Seizures*: To help the players realise the possible features that could cause seizures in the content, a combination of 'Loss Aversion' and 'Interactive Narrative' mechanics are used. At the start of the level, the Assistive Robot breaks down because of multiple flashing points, and through conversation, the player turns them off, and reduces the area they affect. Finally, the player makes a device for the Assistive Robot to ensure this does not happen in any other room. From here onwards, the player would need to recharge the device at intervals to remind them of the seizure issues.

- *Navigable*: Provide ways to help users navigate, find content, and determine where they are. This guideline is suitably mapped to a 'Discovery' mechanic. The level starts with the player faced with many rooms and corridors. The player needs to finish a task such as uploading or downloading a file in order to progress. The Assistive Robot suggests using the map and prompts the player to find the home page, check the page title and check for any breadcrumbs to go back to where they were after accomplishing the task.

3) Understandable

This category consists of three core guidelines, which are concerned with adhering to information and the operation of user interface must be understandable.

- *Readable*: Make text content readable and understandable. This guideline has been mapped to a selection of 'Puzzles' mechanic, where the level would take the default language of the game and use a different language to show the instructions. The player needs to find the 'http header' and change it back to their own language.

- *Predictable*: Make web pages appear and operate in predictable ways. The guideline is mapped to a 'Room Escape' mechanic. The player would start in a locked room and there is a panel next to the exit door. The player needs to find the code first; the 'Input' field is locked, so the player needs to create an 'on focus' for the input in order to enter the code. Finally, the player must create a 'submit' button with a 'select tag' to submit the passcode.

- *Input Assistance*: Help users avoid and correct mistakes. A 'Connect the Dots' mechanic is mapped to this guideline, where the player needs to connect validation and labels to fields in order to enter the information needed to progress to the next level.

4) Robust

This category consists of one core guideline. The category definition states content must be robust enough that it can be interpreted reliably by a wide variety of current and future user agents, including assistive technologies.

- *Compatible:* This guideline has been mapped to a 'Connect the Circuit' mechanic, where the player is faced with a locked electronic door. The circuit that runs the power to the door is broken and the player would need to fix this. The Assistive Robot is unable to read the page, so it informs the player that the information is incompatible. The player would need to fix IDs, closing and opening tags to make sure the current can run through to the door, so that the Assistive Robot can open the door.

B. Gamification mechanics

Finally, the last stage in our process is to add Gamification mechanics. Previous work by [30] identified a number of Gamification mechanics and how they relate to SDT. In line

with this framework, to fulfil the need for autonomy, our framework includes an *avatar, a profile, and a configurable interface* that would allow users to personalise the tasks they undertake. Similarly, the need for competence is fulfilled through the use of *challenges, progressive information,* and *PBL (Points, Badges, Leaderboards)*. Relatedness is finally fulfilled using *connections to social networks* and *messages* to other users.

IV. CONCLUDING DISCUSSION

This paper presents the framework behind a gamified system that will be used towards raising awareness and helping with the training of web designers in adopting the WCAG 2.0. As opposed to previous work, which mainly concentrates on providing tools and methods that incorporate those guidelines, in this paper we propose a framework that takes into consideration that web designers currently face a lack of awareness and motivation to use such guidelines in the first place. Considering the importance of complying with web accessibility standards worldwide, the proposed framework will leverage the popularity of Gamification, in order to provide a more engaging and interactive solution to raise awareness and train web designers in the WCAG 2.0. It is therefore anticipated that this solution could be a promising intervention in the web accessibility domain. Future work is in plan to address the development and evaluation of the proposed framework into a fully gamified solution in collaboration with web designers and through a comprehensive user study based on the Technology Acceptance Model (TAM) and by employing Harpur and De Villiers' [29] evaluation criteria.

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