Design of a Game Community Based Support System for Cognitive Game Accessibility

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Abstract. Cognitive game accessibility concerns removing unnecessary barriers for people with cognitive disabilities to participate in game play. Cognitive accessibility may involve the content of the game that requires work by game designers with limited time but also perhaps limited awareness of the issues and opportunities. The focus here is on people in the game community without cognitive disabilities to contribute with content for cognitive accessibility. The problem is that there is no support system for game community-based contributions of simplified texts and other modalities in games. This paper presents three iterations of a support system, within a design science framework with prototypes, interviews and observations, to answer: Which requirements need to be met for a game community-based system for making quest descriptions more accessible for people with cognitive disabilities affecting language? How can a system for contributions of simplified text be designed from the perspectives of experienced gamers? The conclusions were: (1) a set of requirements and a digital prototype available online; (2) experienced gamers understood how the interface of the prototype worked; and (3) further support functionality would benefit the users of the system. Future work is to evaluate community contributions by involving people with mild cognitive disabilities in game play studies.

Keywords: Cognition · Game · Accessibility · Community · Simplified text

1 Background

Game accessibility is to remove barriers unnecessary for playing a game. Cognitive game accessibility is a field that requires more attention and relatively few games have been developed for people with cognitive disabilities [1]. Previous related work is e.g. Grammenos, Savidis [2] who developed a structured method to design universally accessible games with design alternatives and user attributes (including cognitive impairment) to create user profiles. Another method is to simulate personas with impairments [3]. These methods are especially useful to identify issues early with less effort. Barriers for cognitive accessibility need to be addressed manually [4, 5], but dynamic adaptation can be made of settings, interaction and difficulty [6]. E.g. creating an easy to read text need manual work, but text selection can be done dynamically or

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automatically. Furthermore, designs for people with cognitive disabilities should consider three individual configurations, found by Torrente, Blanco [7]: (1) identity, for instance having a character resembling themselves; (2) goals, e.g. a task-list in the game; and (3) the user interface. One example could be if the player accepts a quest (or mission) in a game, specific actions to complete the quest could be inserted into a task-list.

Text based quest descriptions are common in role-playing games, one of the most popular genres. Text is one of the modalities that can be a challenge as language is affected by e.g. autism, learning disabilities, Alzheimer and acquired brain injury [8]. Simplified text is an easier to understand version of the same text [9]. While simplified text is not the only solution, it may be a first step. In addition, audio, video and images of quests may be a multimodal approach but takes more resources to store and create. As cognitive game accessibility involves the content of the game such as quest descriptions, it requires work by game designers who may lack budget, awareness or both to address the issue. Thus, there is a need to define requirements for developing and evaluating a support system where people in the game community (including game designers) can contribute with simplified quest descriptions.

The system design may be inspired by wikis with considerations taken for games, as well as usability, accessibility and motivation mechanisms for contributing. The latter may be achieved with social rewarding systems with author rankings [10]. Ling, Beenen [11] says that uniqueness of contributions is important for motivation, which may be achieved by limiting the number of highest ranked contributions and also showing which quests are currently being simplified by others. Requirements may include non-text, linear formats for information and guidance; minimize the need for decisions and memory; and have adaptable contrasts as well as size of buttons and texts, based upon the review by LoPresti, Bodine [8]. This paper presents results based on two bachelor theses (study 1 and 2 below), supervised by the last author.

1.1 Problem and Research Questions

People with cognitive disabilities affecting language may be excluded from playing games where language is central, such as role-playing games. The problem is that there is, to the best of the authors' knowledge, no system for game community-based contributions of simplified texts and other modalities in games. The research questions were: (1) Which requirements need to be met for a game community-based system for making quest descriptions more accessible for people with cognitive disabilities affecting language? (2) How can a system for contributions of simplified text be designed from the perspectives of experienced gamers?

2 Methods

Two studies were conducted within the framework of design science, where different approaches and methods can be iterated to explicate problems, define requirements, and develop, demonstrate and evaluate an artefact [12]. Here the artefact is a support system developed in three main iterations with the target group of contributors.

2.1 Methods in Study 1 and Iteration 1

In iteration 1 an example interface was prototyped as a slideshow with hyperlinks and used during data collection. A list of requirements for iteration 1 was based upon basic design principles by Norman [13] such as established conceptual interaction models in game menu interfaces and guidelines for defining requirements [12]. Four participants were selected with purposive sampling, i.e. selected on basis of being part of the gaming community as gamers, representing the target group of contributors to the system. The aim in study 1 was to define requirements for a support system to contribute with simplified texts. Thus, focus was on usability rather than accessibility, and none of the participants identified as disabled.

Each participant first tried the interactive slideshow prototype, and were asked to think-aloud concurrently while being observed. Following the observation, the participants were interviewed on what requirements they would have on the interface, what they thought about the functionality of the prototype, how they could be motivated to contribute with simplified texts and what they would like to add. Finally, they were shown the list of requirements and were asked what they thought about the requirements, and if some should be edited, removed or added. A semi-structured interview guide was used with main and follow-up questions. Observation notes and transcriptions were analysed thematically. After each interview, the requirement list was updated before the next interview. Interviews were about fifteen minutes each.

2.2 Methods in Study 2 and Iterations 2 and 3

In iteration 2 a paper prototype was created and tested, with the different interface layouts presented on sheets of paper. Interactive elements were cut out and placed based on user interactions, which is more flexible than an interactive slideshow used in iteration 1. In iteration 3 a digital game prototype was developed with approximately one minute of game play. It contained a simple, linear game level to focus on quest descriptions rather than game play in general, where two quests appeared with many words relative to the content. It was developed in HTML5 and JavaScript to be easily available online. Requirements for iterations 2 and 3 were based upon the results in the first study.

Semi-structured interviews of approx. twenty minutes each was the main method for data collection in both iterations, while a minor observation was made while the participants interacted with the interface before the interviews. Similar to study 1, participants were here also experienced gamers (who played at least seven hours per week, or approx. one hour per day) to enable a deeper understanding of games related to the second research question. There were three and six participants in iteration 2 and 3, respectively (nine in total). They were asked also to add e.g. a new text or vote on someone else's text. A web camera was used to record the audio of the interviews and transcribed after. Questions were about the interface design and their interaction with it including why they acted as they did. Thematic analysis was made using comments in Microsoft Word with both in-vivo and descriptive coding, resulting in categories that were grouped in themes that affected the design of the system based upon the second research question.

3 Results and Analysis of Study 1

Study 1 comprised iteration 1 (a set of requirements).

3.1 Initial Requirements and Development of the First Prototype

The initial interfaces (Figs. 1, 2, 3) in iteration 1 were based upon basic design principles by Norman [13]. Standard controls like scrollbars were used for recognition from other applications, and high contrasts were used to ease finding interface elements. This first prototype was developed as a slideshow with hyperlinks to demonstrate the basic idea of the artefact to the participants, to ease grasping the concept and be able to provide data for requirements.

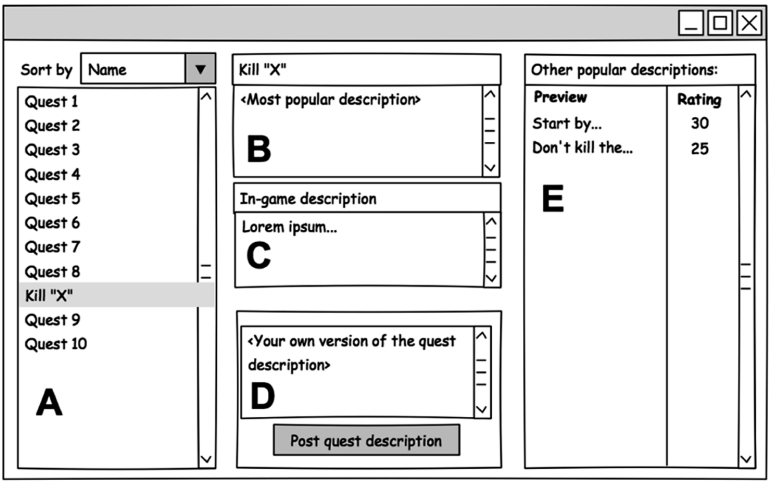

Fig. 1. Quests with existing descriptions and an input field.

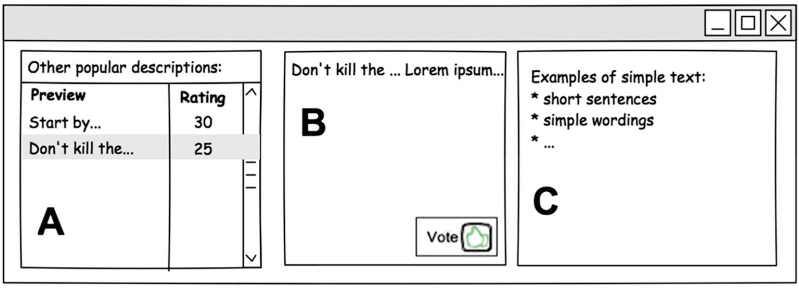

Fig. 2. Quests with other popular descriptions and guidance for evaluation and voting

Fig. 3. An option to evaluate the quest description and contribute upon finishing a quest.

In Fig. 1, the different areas of the interface can be described as follows: A: the quests were listed top down, where a selected option could be highlighted; B: the most popular description, i.e. the one with most likes; C: the original description; D: an input field to write your quest description; E: other contributions sorted by popularity for inspiration or to like; selecting any of these brings the user to the interface in Fig. 2, where the interface areas were: A: list of existing contributions where the selected item could be highlighted; B: the selected description, with a "Vote" with a thumbs-up button to like the description, modified to not be mixed up with similar buttons in social media applications; C: guidance to write simplified texts. Figure 3 illustrates an example interface when a player has completed a quest and is asked if s/he was pleased with the quest description. If not s/he may choose to provide a better description by opening the interface in Fig. 1.

3.2 Iteration 1: Requirements Based on Demonstration of the First Prototype

The following requirements are categories based upon think-aloud observations followed by semi-structured interviews: (1) A ranking system to promote the best contributions; (2) A moderating group to avoid cheating and other unwanted behaviour; (3) Search and sort functions of all content; (4) A list with highest ranked authors and contributions to reward authors and aid readers; (5) Support of multiple languages but also other modalities than text; (6) A function to mark favourite authors and contributions to more easily find them again; (7) Control formatting, grammar and length of contributions; (8) The size of rewards should be proportional to the contribution and ranking, but not in a form that is central to game play. As one participant expressed it: "It would be unfair if you could use this [the support system] to get a lot of advantages or xp [in the game]"; (9) Support creativity by enabling more advanced descriptions and guides, including other modalities such as arrows, pictures and waypoints as well as dynamic bullet-lists that is automatically updated when something is done; this could be a meaningful reward in itself for gamers who like to create guides; (10) Peer feedback and feedback on use of contributions to each author, to further increase motivation to participate; (11) A standards-based, accessible interface that can be individually adapted on demand; (12) Mark quests with complex descriptions to ask for help; (13) Report improper or low quality descriptions, which also must have consequences; and (14) The ranking system must be easy to find and use in the game, also accessible for people with other disabilities or limitations.

4 Results and Analysis of Study 2

Study 2 comprised iteration 2 (a paper prototype) and iteration 3 (a digital prototype).

4.1 Iteration 2: Demonstration of the Second Prototype

The second prototype was based upon the requirements in iteration 1 with an additional requirement: (15) Recent: New descriptions should be shown separately to have a chance of discovery. Figure 4 shows one example of the paper-based prototype with the interface for viewing, selecting or creating a simplified text.

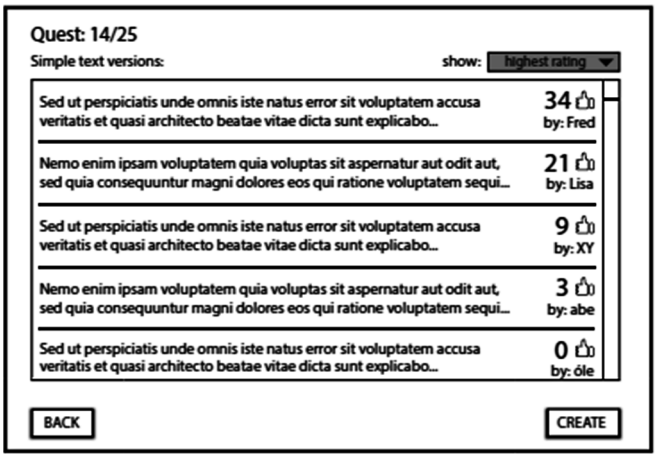

Fig. 4. Paper prototype example in study 2

Themes (in *italics*) and categories (underlined) from the prototype demonstrations:

- *Symbols and buttons*. Unclear: While the symbol for voting for a text was a thumbs-up (Fig. 4), the symbol for marking a favourite author was a star. The participants mixed up these two symbols. Wishes: Descriptions of the functions of buttons, and quick navigation to go directly between Create text, Return to quest text, and Switch original/simplified text.
- *Texts*. Unclear: An issue with the paper prototype (Fig. 4) was the non-semantic text examples, which caused some confusion. As this text had no meaning, the participants could not guess what would happen before selecting it and had to learn by trial and error.
- *Design*. Unclear: Have uniform positioning of buttons across interfaces to avoid confusion. Clear: Use well-known standards. Wishes: Use a position that is more associated with the simplified text contribution for the button group used to like, flag and comment. Requirements: The system should be simple and easy to use.

- *Functions*. Unnecessary: Having both voting of texts and favourite authors as well as four ways of sorting texts could be too complex. Editing: Support for synonyms and alternative sentence structures could aid while editing. Read-out loud: Support for text-to-speech could help people with reading disability. Incentive: Response in the form of likes was seen as valuable incentives to contribute with more texts. Moderation: This was viewed as crucial for sustainability of the system. Flaws: Too much work (clicking) to find and select a simplified text.

4.2 Iteration 3: Development, Demonstration and Evaluation of the Third Prototype

In the third iteration, a digital prototype (Fig. 5) was developed based upon the findings from the second iteration, and is available online[1].

Fig. 5. Selecting simple text versions of a quest

Themes (in *italics*) and categories (underlined) from prototype demonstrations:

- *Use*. Clear: The interface was perceived as familiar and easy to use. Incentive: Interaction with others through visible response on contributions and having followers was motivating. Attitude: Participants expressed a positive view of the system and its purpose.
- *Design.* Clear: The design was logically structured. Bad: The design could be more aesthetically appealing. Suggestion: Two participants missed the Guidelines button in the interface for creating new texts (Fig. 6); a participant suggested that the Browse buttons could be moved down and the most important guidelines could be viewed in the top right position.
- *Buttons.* Clear: The buttons seemed easy to understand, perhaps due to extra information when hovering over buttons, and/or following conventions from

[1] Digital prototype. https://github.com/Jaernbrand/Thesis_Prototype [Accessed 2017-06-09]

Fig. 6. Create simplified text

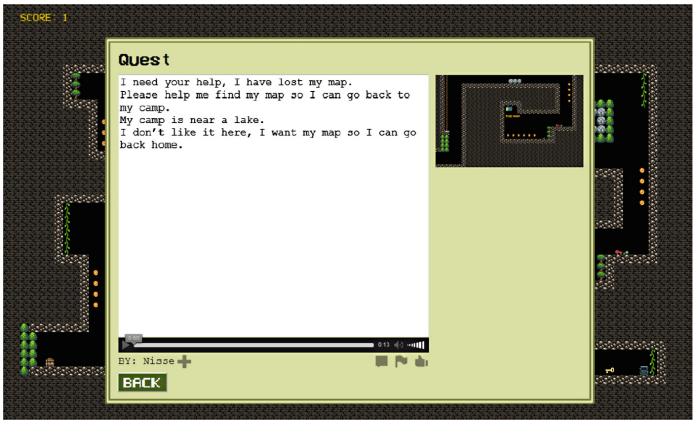

Fig. 7. Quest interface with simplified text and audio descriptions

Youtube and Facebook as one participant expressed it. Unclear: The purpose of the plus sign (Fig. 7) was unclear (although all selected correctly), and the Browse buttons (Fig. 6) could need better descriptions. Suggestion: Replace the plus sign with something more clearly related to favourites. The flag (Fig. 7) was red if someone requested a simplified text; this symbol was perceived a bit too severe; perhaps a different colour could be enough.

- *Functionality.* Wishes: Voting and flagging of comments was wished for as a self-sanitizing feature, as well as having a mean score of each writer to sort on. Restrictions: Participants viewed moderation of texts and comments as crucial to make the system popular and useful. Also, instead of uploading local images the Browse buttons could show a list of screenshots from the within the game only.

5 Discussion and Conclusions

This paper has suggested a solution to the problem of support for game community-based contributions of simplified texts and other modalities in games. This may be used as a design alternative for cognition user attributes in a unified design method of accessible games [2]. The research question in the first study was: Which requirements need to be met for a game community-based system for making quest descriptions more accessible for people with cognitive disabilities affecting language? A set of 14 requirements were argued for, based upon previous research [8–11, 14] and feedback from participants. These requirements were used in the second study where the research question was: How can a system for contributions of simplified text be designed from the perspectives of experienced gamers? Both a paper prototype and a digital game prototype was designed and evaluated and another requirement was added. The order of fidelity levels of prototypes may seem a bit backward with a digital slideshow first and then a paper prototype. This partly reflects the fact that this paper is based upon two studies, with two groups of students who made their choices of methods independent of each other. However, it was motivated by having a more flexible approach with paper prototyping in the second iteration, when interacting with participants and discussing the design.

The system has two main target groups; people with and without cognitive disabilities in the game community. Experienced gamers without cognitive disabilities have been involved to evaluate the interface for contributing with simplified texts, which was the aim of the system for input of texts in this paper. The conclusions are: (1) a set of requirements; (2) that experienced gamers understood how the interface worked, but also (3) that further support functionality would benefit users of the text input system.

A limitation of the two studies in this paper is that people with cognitive disabilities affecting language have not been involved in the use of the simplified texts. This may be further studied within a game genre where language is central such as role-playing games, together with people with mild cognitive disabilities affecting language. The digital game prototype in study 2 could be expanded upon for such a study, where the interface for selecting a simplified text may need further work for accessibility, such as adding screen reader support (to meet Requirement 11 and 14). Furthermore, the selection of participants was not randomized and it is also a small sample. With the existing prototype, a larger study could be done including all game students at a department or several departments through surveys to more easily be able to generalise about the game community, and interviews of people with cognitive disabilities affecting language regarding the simplified texts produced by people without cognitive disabilities.

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