Game over: Learning by dying

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Dimitris Grammenos
Foundation for Research and Technology - Hellas
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Game Over: Learning by Dying

Dimitris Grammenos

Foundation for Research and Technology - Hellas (FORTH)

Institute of Computer Science

N. Plastira 100, Vassilika Vouton

GR-70013 Heraklion, Crete, Greece

gramenos@ics.forth.gr

ABSTRACT

This paper presents the design and evaluation of "*Game Over!*", which is the world's first *universally inaccessible game* (i.e., a game that can be played by no one). The game is meant to be used as an educational tool for disseminating and teaching game accessibility guidelines. This is achieved by providing game developers a first-hand (frustrating) experience of how it feels interacting with a game that is not accessible, due to the fact that important design rules were not considered or applied during its design. Both the overall concept and the approach followed were evaluated and validated through: (a) an on-line survey; (b) "live" feedback from players and developers; and (c) public opinions and critique collected from numerous Web sites and blogs where "Game Over!" was presented and discussed. The evaluation outcomes strongly suggest that computer games and humor constitute a perfect match for reaching out, motivating and educating the game developers' community in the subject of game accessibility.

Author Keywords

Game accessibility, game-based learning, design guidelines

ACM Classification Keywords

H5.2. Information Interfaces and Presentation (e.g., HCI): User Interfaces - *Ergonomics; Theory and methods.*

INTRODUCTION

In the past few years, the domain of game accessibility started gaining increasing attention both by the scientific community and the game industry. Related papers have been published in international conferences (e.g., [6, 2, 17, 18]) and a handful of articles appeared on gamasutra.com (e.g., [5, 16, 10]), which is the most visited and referenced web site for the video game industry and professionals. In 2005 and 2006 the Retro Remakes web site run game development competitions promoting accessibility in

gaming [34]. Also in 2006, donationcoder.com conducted an accessible game coding contest [37]. In 2007, the KQED Public Broadcasting in San Francisco broadcasted a documentary entitled "Video Games - Access For All" [26] and BBC has made some of its children's games switches accessible [4].

A key tool for designing and implementing accessible games is the related consolidated know-how, which usually comes in the form of collections of guidelines. Unfortunately, despite the indisputable value and importance of guidelines-related knowledge, as was discovered by several studies (e.g., [19, 35, 38]) regarding the use of standards and guidelines in the field of Human-Computer Interaction (HCI), such accumulated knowledge is frequently either ignored or not understood, and, therefore, not appropriately exploited, especially in the game industry, where the majority of developers are quite young and inexperienced.

As a means to contribute overcoming this problem, this paper introduces "Game Over!", the world's first *universally inaccessible game*, which is meant to be used as an educational tool for disseminating, understanding and consolidating game accessibility guidelines in the game developers community.

The paper is organized as follows. First, some background on related work is provided. Then, the design rationale and overall concept of the game are introduced. Next, the actual game, its levels and gameplay are described in more detail. Finally, the results of a Web survey on the potential educational value and impact of the game are presented, followed by some highlights of opinions collected from web sites around the world. The paper concludes with recommendations for improvements and future work stemming from the experience gained through this project, and also collected from the numerous contributions received by several game developers through direct or e-mail communication.

In the context of this paper, the term "accessibility" is not associated only to people with physical, sensory or mental disabilities (which is typically the case), but it also refers to all those gamers that may not be able to fully experience - or even play - a game due to: (a) the environment they operate in, e.g., a person in a noisy environment is

situationally deaf, someone using a screen in bright sunlight is situationally blind; (b) the hardware and software they use, e.g., a mobile device with a small screen, an older browser, a different operating system; (c) their gaming skills and preferences, e.g., a person who does not like or, experiences difficulty in using 10 different keys in order to kick the ball in a football game.

BACKGROUND AND RELATED WORK

Game Accessibility Guidelines
Currently, there are two international task forces working towards shaping and consolidating game accessibility guidelines [31]:

1. The Games Accessibility Special Interest Group (GA-SIG) of the International Game Developers Association published in 2004 a White Paper [20] about game accessibility, which included a list of possible approaches for providing accessibility in games. Also, the SIG has created a "Top Ten" list of items game developers can do to start increasing the accessibility of their game with minimal effort on their part and without greatly affecting (and perhaps even improving) general game play [21].

2. A group lead by the University of Linz and the Norwegian company MediaLT based on a set of "Guidelines for the development of entertaining software for people with multiple learning disabilities" published by MediaLT in 2004 [28], and the guidelines published by GA-SIG, aims to create something similar [29] to the W3C/WAI Web Content Accessibility Guidelines [43].

Both efforts are noteworthy, since they provide valuable contributions towards achieving the goal of game accessibility. Nevertheless, in the past decade, the HCI community has realized that guidelines, when used in their original form, are quite ineffective and unusable in the hands most practitioners.

Although several reasons can be mentioned (e.g., [35, 38]), the basic problem is that guidelines typically come in an abstract, context-independent form which tends to make them ambiguous or too abstract to be applied in a specific context [19]. This means that, in order for them to be used in practice, they must first be "translated" by taking into account the intrinsic characteristics of the specific design space. This task is not trivial, since it requires a very good understanding of: a) the (negative) situation that each guideline aims to remedy; and b) the (positive) state that it endeavors to achieve. Furthermore, guidelines are often conflicting or, in certain occasions, may create new problems while solving another. Thus, the person employing the guidelines must first have a concrete idea, preferably through hands-on experience, of the issues addressed by each guideline.

As a means to overcome some of the inherent problems of guidelines for game accessibility, Folmer [10] suggested the use of interaction design patterns for capturing and documenting design experience. This approach has clear benefits, but still presumes that game developers are: (a) aware of the design patterns; and (b) willing to spend some time studying and internalizing them.

Learning Good Design Practices through Counter-Examples
The notion of using bad examples for learning good design is certainly not new. Donald Norman [30], in his seminal book "The Psychology of Everyday Things" with the infamous "Teapot for Masochists" cover, included several examples of bad design in order to imprint his point to the readers' minds. More than a decade later, Johnson [24] dedicated an entire book to illustrating common pitfalls in user interface design. Currently, several websites exist that showcase bad design examples of both real-world objects and software user interface design, such as "Bad Human Factors Designs" [3], "Interface Hall of Shame" [23], "Worst of the Web" [45], etc.

In the field of Software Engineering, the use of *anti-patterns* (as well as *patterns*) for avoiding common design pitfalls has gained considerable popularity [7, 27]. As a simple *anti-pattern* one can consider a specific piece of negative advice, an example of bad practice, or a solution that creates more problems than it addresses [7]. In contrast to guidelines, anti-patterns are contextualized, and thus are easier to understand and use. Another closely related concept is that of *amelioration pattern,* i.e., a combination of an anti-pattern with constructive advice on how the bad solution can be remedied [42].

Currently, there are no established anti-patterns (or even a template to record them) in the field of HCI [42], while their impact and benefits in HCI education are under investigation [25, 42]. Still, there seems to be a general agreement that presenting a specific bad example (and not just abstract advice), along with information on how to correct the related problems, can have positive effects.

Unplayable Games by Design
In 1986, a video game was created for the Nintendo Famicom (NES) by the Japanese comedian, actor, presenter, author, poet, painter, and film director, Takeshi Kitano (who is "a man who hates videogames" as the game's title screen states). The game was entitled "Takeshi no Chousenjou" (Takeshi's Challenge) and attempted to break as many video game rules as possible [44], giving the players several outrageous tasks to complete, such as holding a button down for 4 hours, singing karaoke for 1 hour and having to hit the final boss twenty thousand times [15]. Strangely, this game was one of Famicom's hits. Still, it was never released outside Japan. This example shows that unplayable games can be fun, and this was a goal that we also wanted to achieve with "Game Over!"

Learning by Dying

"Learning by dying" [9] is a term used in game design to describe games where the only way for a player to get over the obstacles and challenges faced is pure luck or "trial and error" - where the error usually results in the player getting killed. This approach is generally considered as a major design flaw, stemming from bad or incomplete game design, as well as lack of imagination. The player should always be given a clue – no matter how subtle or ingenious that might be – so that in case of dying s/he can only blame her/himself, not the designer [35]. The design of "Game Over!", aimed to create an everlasting impression to game designers about the negative effects of inaccessible game design. This was achieved by exploiting the frustration that *learning by dying* causes to players.

MOTIVATION AND RATIONALE

Experience accumulated through the delivery of tutorials and lectures in major scientific and game development-related conferences and through direct communication and discussion with several game developers has shown that, typically, at first, most developers consider the subject of game accessibility either as an "exotic" theme that should not concern them, or as a very tough issue that requires a lot of technical expertise and tangible resources. However, when people learn more about what some people have to go through in order to play games, in combination with a few simple design solutions that would directly increase game accessibility (as well as usability), they seem to be very willing to invest more time and effort into it.

Thus, what seemed to be much needed was a "vehicle" that would transport game developers though the threshold that divides lack of knowledge (or indifference) from awareness and engagement. Obviously, this vehicle could not be a long list of guidelines.

According to the latest demographic survey of the IGDA [22] the average age of game developers is 31 years, while the average number of years working in the computer games industry is just 5.4, with the majority of workers having 2 years or less of experience.

Furthermore, it is known that game developers do like playing games. For most of them, this was the driving force for selecting their occupation. Interestingly, gamers seem to have an excellent memory regarding the best and the worst games they have ever played. Whenever a bad design example is shown in a lecture, most people in the audience will instantly recall quite a few games they have played that had a similar problem. Experience also shows that the gamers' recollections of good games are transient, as they are often replaced by more recent or better examples, but notable failures last for a lifetime.

By taking into account the above design parameters, it was concluded that the required guidelines vehicle could be incarnated in the form of a computer game that would somehow break game accessibility design rules, providing developers with hands-on experience and food for thought on game accessibility problems and their potential solutions.

Indeed, following a *game-based learning* approach [32] can have several advantages, since a game:

1. is the most adequate medium for the addressed target user group;

2. offers motivation and engagement [8];

3. can provide a direct (frustrating) experience of how it feels when interacting with software that is not accessible;

4. is fun - definitely more than a text-based list of "do's and "do not's";

5. can have a long lasting impression.

DESIGNING "GAME OVER!"

Requirements

The research hypothesis underlying the development of "Game Over!" was that a computer game is a suitable means for: (a) increasing game developers' awareness about game accessibility; and (b) teaching them some basic related principles while having fun.

Thus, we decided to develop a "proof of concept" game for testing this hypothesis. As a first step, in order to rapidly test the concept, a simple 2D game was selected that would require reasonable resources. The basic high-level requirements set at this stage were that the game should:

1. be very easy to play, having a well-known goal and mechanics (probably an all time classic), so that gamers would easily understand the problem and its cause;

2. break game accessibility rules in a bold and straightforward way;

3. break one rule at a time, in order to simplify the message, making easier for players to understand what is going wrong and why;

4. concentrate on major, typical accessibility problems related to blind, partially sighted, color-blind, motor-impaired, deaf, and novice players;

5. provide some advice for solving each problem after exposing the player to it, following the concept of amelioration patterns;

6. employ humor for lightening up the "educational" process, thus making it more enjoyable; and

7. run on as many computer platforms as possible.

Game Design

A reversal of the stereotypical Space Invaders scenario was selected as the main game theme. The player assumes the role of an alien (named Resol – which is Loser read

backwards), hopelessly struggling to protect the universe from the merciless invasion of the terrestrial invaders.

This approach serves a two-fold objective. On the one hand, it allows most players to know what to expect when playing the game, while, on the other hand, the reversal (that also has a comical effect) predisposes players that there is something radically different about this game.

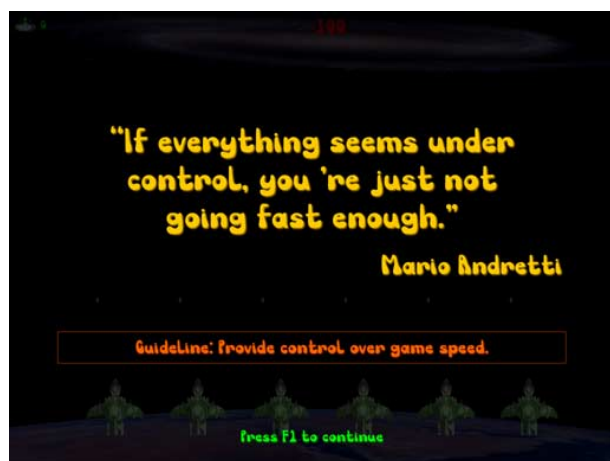**Figure 1: Indicative "Game Over!" screenshot**

Figure 2: Example of the punch line and guideline displayed at the end of "Level 9. Chill Out!"

The game was entitled "Game Over!" for two reasons. First, because there is no way of winning, and thus the game is over before even starting playing it. Secondly, the title serves as a pun on the "Game not Over" motto of the Game Accessibility SIG of the IGDA. The game's subtitle (i.e., "*because no one can save the universe*") is a paraphrase of the Game Accessibility project's [11] "*because everyone wants to save the Universe*" slogan.

As expected, the basic gameplay is quite simple (see Figure 1). The player controls a flying saucer that is located near the top of the screen (in contrast to the classic Space Invaders game), can move left to right and vice versa, and throw bombs in order to destroy enemy spaceships, while at the same time trying to avoid incoming fire.

The game comprises twenty-one levels, each of which violates a fundamental game accessibility guideline. The guidelines were selected by reviewing the related existing collections (e.g., [20, 21, 28, 29, 33]), the authors' experience, and also the feasibility of including them in the selected game style. In some cases (e.g., "*provide control over game speed*") there are two levels addressing both extreme cases of the same guideline.

The player can play the game from the start, or directly jump to a specific level. At the beginning of each level, its title is presented along with some guidance (e.g., the controls that can be used and the player's goal). In order to move from one level to the next one, the player must first lose three lives. Each time that a life is lost, one hundred points are subtracted from the player's score.

At the end of each level, a famous quote related to the level's content is recited (i.e., a "punch line") providing a humorous note, and the guideline that was violated is displayed (see Figure 2). At the end of the game, a summary of the level titles and the corresponding (violated) guidelines are presented.

Game Levels

Below, an overview of the game's levels is provided, along with their gameplay characteristics, the guideline that is violated, and (in parenthesis) the primary target user group it concerns. Some indicative screenshots are illustrated in Figure 3.

Start Screen

Although the start screen is not a game level *per se*, an accessibility problem is also induced. In order to start the game the player must concurrently press "Control + Shift + Enter + Home + F3 + F12 + Right Arrow".

Guideline: It should be possible to start playing the game using a single button (motor-impaired).

Level 1: Learning to Die

This is meant to be a tutorial level, but, unlike the typical case, it is not targeted to the player but to the enemy spaceships. Thus, the player can be destroyed but its enemies can't.

Guideline: Provide a tutorial mode (novice players).

Level 2. Piano Man

The player must use awkward key combinations to control the spaceship (Shift + L + Left Arrow to go left, Shift + R + Left Arrow to go right, Shift + F + Space to fire).

Guideline: Avoid simultaneous button pressing (motor-impaired).

Level 3. Hunt and Peck

The control keys are continuously being randomly redefined and the player has to find them (which actually is impossible).

Guideline: Allow redefining the controls (motor-impaired).

Level 4: Look Ma, No Hands!

A so-called "single-switch level", where the player can only

fire using a single button but not move, due to lack of a related design consideration. *Guideline: Allow playing the game with a smaller number of controls, even with just a single switch / button (motor-impaired).*

Level 5. Spell Check

The player has to type "left" to move left, "right" to move right, "fire" to fire and "pause" to pause the game.

Guideline: Support alternative input techniques (all players).

Level 6. Out of Control

The player can do nothing since this level can only be played with an imaginary in-house developed controller.

Guideline: Support alternative controllers (all players).

Level 7. Die (not so) Hard

This level is extremely difficult. A large number of spaceships is attacking the player, rapidly firing an immense number of rockets.

Guideline: Allow adjusting difficulty level (all players).

Level 8. The Fast and the Furious

The gameplay at this level is incredibly fast.

Guideline: Provide control over game speed (all players).

Level 9. Chill Out!

The gameplay at this level is ridiculously slow.

Guideline: Provide control over game speed (all players).

Level 10. Touchy

The player's controls are very sensitive. The lightest touch of a key results in an unpredictable amount of movement.

Guideline: Allow adjusting control sensitivity (all players).

Level 11. Hakuna Matata

Information about how this level can be played is provided in Swahili.

Guideline: Use simple language and provide easy to understand instructions (all players).

Level 12. Over the Rainbow

The player is instructed to shoot only the BLUE spaceships, otherwise s/he will be destroyed. The catch is that the enemies are rendered in grayscale.

Guideline: Do not rely on color alone (color-blind).

Level 13. Low Budget

All game elements are rendered in a tiny size.

Guideline: Allow magnifying the text and graphics (low vision).

Level 14. XXXL

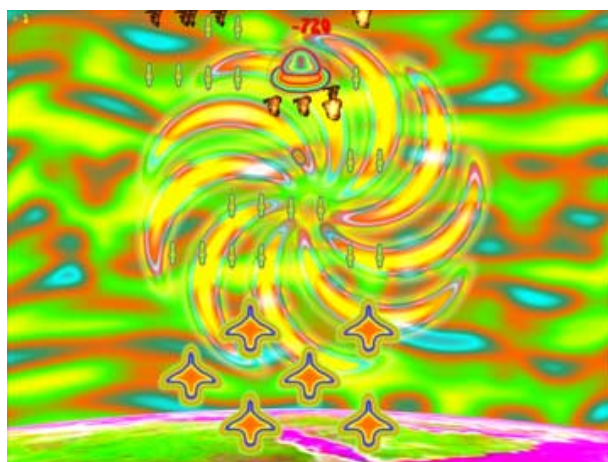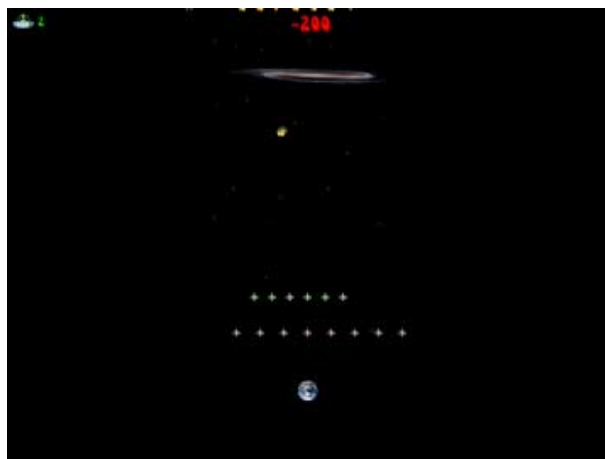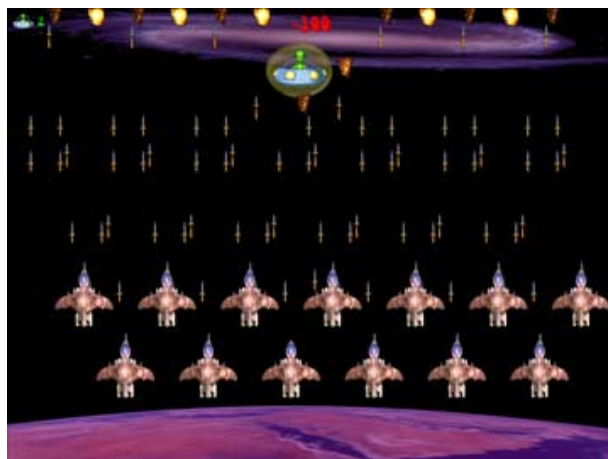The game elements are magnified so much that the game cannot be played.

Figure 3: Screenshots from some levels of Game Over!:
a. Die (not so) Hard; b. Low Budget; c. Groovy; d. The Bright Side of Life

Guideline: Make sure that the game is still playable when resized (low vision).

Level 15. The Bright Side of Life

Both the background and foreground graphics are rendered using very bright, whitish colors, so there is almost no contrast among them.

Guideline: Allow adjusting contrast, brightness and colors (low vision).

Level 16. Groovy

Very complex, flashing, psychedelic graphics are used for the background and foreground graphics.

Guideline: Allow adjusting visual detail (low vision).

Level 17. See No Evil, Hear No Evil

Enemy spaceships shoot missiles that the player cannot see nor hear.

Violated Guideline: Provide 3D audio cues (blind).

Level 18. The Art of Noise

The player is playing in the dark. Fortunately, the game provides 3D audio cues and audio description about the enemy spaceships and incoming fire, but unfortunately the music is so loud that the audio descriptions can not be heard.

Guideline: Provide separate volume controls for music, speech and sound effects (blind).

Level: 19. Chatterbox

The player is again in the dark. This time the game provides audio description about the enemy spaceships and incoming fire, but it is so superfluous that it is totally unusable (e.g., "Look out! There is a big spaceship that looks really mean on your left").

Violated Guideline: Provide meaningful and timely spoken information (blind).

Level 20. Smooth Talker

The player is in the dark and audio description is provided at either extremely fast or slow rate.

Violated Guideline: Provide speech rate control (blind).

Level 21. Speechless

The player is asked to listen to "the voice" and fire whenever instructed to do so. If s/he doesn't, or if s/he does it any other time, s/he loses. Unfortunately, "the voice" cannot be heard.

Guideline: Provide closed captions for dialogue and sound effects (deaf).

Game Development

Although it might sound counterintuitive, in order to create a universally inaccessible game, a universally accessible game had to be designed and developed first. This is because, as mentioned above, each game level should violate a large variety of guidelines with very diverse contents and goals, while, at the same time, it should be possible to easily experiment with several combinations of alternative game parameters, so that they best reflect the effect of the violated guidelines. On top of that, the game

had to be extensible, so that more levels could be added in the future.

Thus, during the process of developing "Game Over!", a game entitled "Terrestrial Invaders" was born [40]. Terrestrial Invaders is packed with accessibility features and can address most of the accessibility guidelines that "Game Over!" violates.

"Game Over!" was developed in a preview version of Actionscript 3.0 using Adobe Flash® Professional 9 Public Alpha [1]. The entire game and all its individual parameters (lives, speed, difficulty, controls, sounds, captions, colors, graphics, firepower, etc.) are loaded from a standard XML file. Thus, using any text editor it is quite simple and straightforward to add new levels, or edit the existing ones. Furthermore, it is possible to add new graphics and sounds through external Flash libraries.

"Game Over!" is available as freeware [39] for MS-Windows, Linux and Mac OS X.

EVALUATION

During both the design and development phases of "Game Over!" several "in-house" evaluation sessions were conducted with the participation of one experienced software engineer / game developer, a usability expert, a graphic designer, three post-graduate and two undergraduate students of the Computer Science Department of the University of Crete.

Initially, a mockup of the game illustrating the basic concept was created in MS Powerpoint®. The mockup was presented to all the evaluators and positive feedback was received. Additionally, several comments regarding the potential gameplay, the game presentation and the sequence of the levels were collected.

During game development, each time a new level was available it was playtested by all the evaluators in order to detect bugs, aesthetic improvements and usability / understandability problems.

Web-based Feedback Form Results

When "Game Over!" was released on the Web, an electronic form was created for collecting evaluation feedback. At the end of the game, players are prompted to access the form on the Web, or send their opinion through e-mail. The form comprises two parts with game-related and demographic questions respectively. Filling in any of the demographic questions is optional.

The game-related part contains 5 questions using a 5-point scale which are accompanied by a text box for noting any additional related comments. Additionally, a question with a free text answer is included. These questions are the following:

1. How familiar were you with the accessibility guidelines presented in "Game Over!" before playing the game?

2. How much do you think that playing "Game Over!" helped you familiarize with game accessibility guidelines and their application?

3. How much fun was playing "Game Over!"?

4. How useful do you think that "Game Over!" can be as an educational tool for disseminating, understanding and consolidating game accessibility guidelines?

5. Would you recommend other game designers / developers to play "Game Over"?

6. Do you have any other comments regarding the game?

The demographic part includes the person's name, gender, country, affiliation, e-mail, and age group.

Forty-nine persons have filled in the feedback form providing at least their e-mail as a means of identification, while 239 have registered in order to receive further information about "Game Over!". The statistical analysis of the quantitative feedback data is illustrated in Figures 5-9. An interesting fact is that out of the 48% that on the first question answered that they knew half or less of the accessibility guidelines presented by the game, on the second question 38% have answered "Very much", 33% "Much", and 29% "Moderately", but no one "Slightly" or "Not at all".
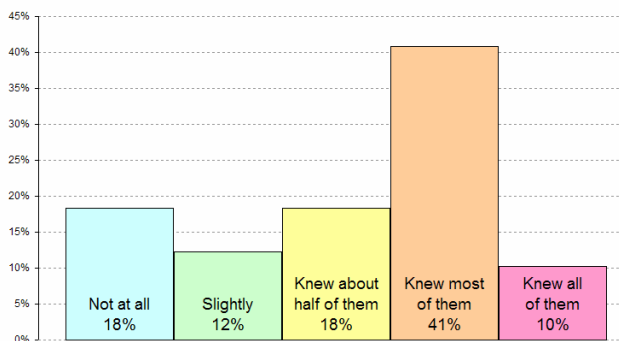

Figure 4: Q1. How familiar were you with the accessibility guidelines presented in "Game Over!" before playing the game?
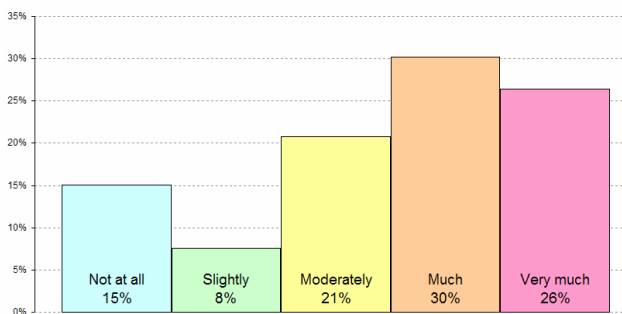

Figure 5: Q2. How much do you think that playing "Game Over!" helped you familiarize with game accessibility guidelines and their application?
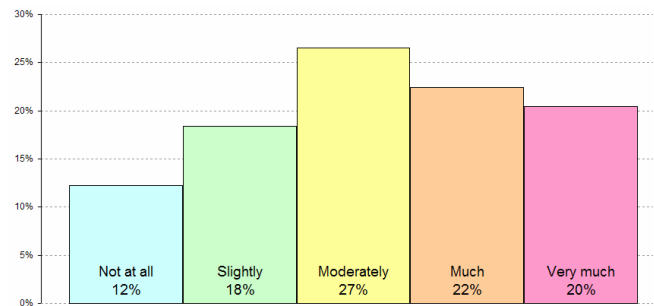

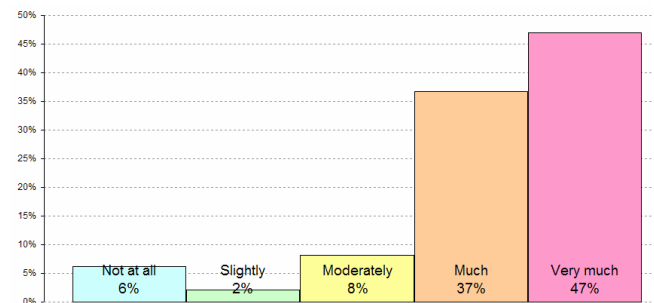**Figure 6: Q3. How much fun was playing Game Over?**

Figure 7: Q4. How useful do you think that "Game Over!" can be as an educational tool for disseminating, understanding and consolidating game accessibility guidelines?
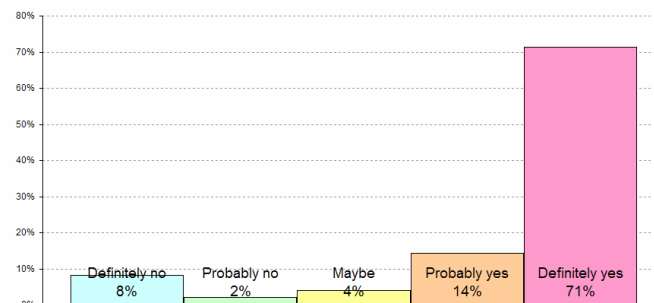

Figure 8: Q5. Would you recommend other game designers / developers to play Game Over?

In addition to the quantitative data that clearly support the initial hypothesis, a considerable amount of qualitative data were collected, also proving (a) the significant value of such a game as an educational tool and (b) that people had fun while playing it. A few indicative quotes are provided below:

- "*Game Over would make (I think) an excellent teaching tool for fledgling developers.*"

- "*I would recommend this to any game mechanics or design teacher.*"

- "*All game designers should be forced to commit this to memory.*"

- "*A very useful way of illustrating the impact of not addressing accessibility principles*"

- "*As an educational tool, it's great.*"

- *"A "must play" game for any game developer."*

- *"Great idea-not making a list with dry commandments, but demonstrating the guidelines in a game."*

- *"I had good fun - thanks."*

- *"It's very, very fun! I've laughed all the time!"*

- *"Who could have thought that playing a game that is meant to be unplayable could be more fun?"*

- *"I had fun, and it seemed genuinely educational."*

Also, the qualitative feedback provides useful information for improving both the game and the overall approach. In some cases, it also sheds some light on the negative scores received. For example, one of the very few persons who gave the worst possible score in all question, in Q2 states that he "*Didn't need a game to demonstrate the need for accessibility guidelines*", in Q5 that he "*Would mention it, but would not recommend playing or downloading it. The concept alone is enough.*" and concludes in Q6 that "*I like the concept, but not the game.*" Also in another case, where a person was very positive with all game aspects except fun (Q3) where he answered "Not at all", explains "*I mean 'not at all' in the good sense here - a good way of demonstrating the impact of the lack of accessibility features.*"

"If it makes just one person stop and think about other people whilst building their games then its job is done. As an educational tool for developers, Game Over is an enlightening and essential play. Check it." http://www.retroremakes.com/wordpress/2007/04/18/game-over/
*"The most frustrating, hilarious, and thought-provoking game I have seen in quite some time. (…) If you are developing software, I *strongly* suggest checking it out."* http://www.educationarcade.org/node/262
"It's a strange concept, but the strangest thing about Game Over! is that it's actually kind of fun. (…) There's something perversely addictive about wanting to keep playing a game just to get a positive score." http://www.joystiq.com/2007/04/20/game-over-an-exercise-in-futility-by-design/
"It is the most fun I've had playing a game in a long time. Ironic, considering the game is unplayable!" http://www.garagegames.com/mg/snapshot/view.php?qid=1458
"Okay, that was really one of the most awesome things I've played in a long time, it was challenging, fun AND hilarious. I was expecting it to be a Supply Lines-esque experience, but it really made me take small things I might overlook to heart." Mincetro, 2 May 2007 http://www.garagegames.com/mg/snapshot/view.php?qid=1458
"Game Over! is actually built to work against you. Everything from the instructions in Swahili to the ridiculous color schemes are meant to throw you off and make the game practically impossible. But why can't I stop playing it?" http://digg.com/playable_web_games/Game_Over_The_Game_Designed_To_Piss_You_Off

Table 1: A few of the positive quotes collected from the Web

Additional Evaluation Feedback
Beyond the direct feedback received through the web-based form, personal e-mails and face-to-face contact, a lot of informal qualitative evaluation data were collected through the numerous web sites and blogs around the world in which "Game Over!" was featured. A lot of interesting information can also be found in several blogs in the discussions among gamers / developers about "Game Over!".

Overall, with the exception of maybe just a couple of personal blogs, "Game Over!" was very positively received and presented, using quite imaginative titles (e.g., "*Game Over!: An exercise in futility (by design)*" [14], "*Game Over! The Game Designed To Piss You Off!*" [12], "*Universally Inaccessible Gaming? Game Over, Man!*" [41], "*Game Over! The World's Most Inaccessible Game*" [13]). Reproducing here all the supportive opinions that can be currently found on the web is beyond the scope of this paper, but still, we cannot resist the temptation of quoting just a few of them in Table 1.

The finished version of the game was showcased and playtested with several players of different ages and background at major international conferences, such as the Game Developers Conference 2007 at San Francisco, USA and the HCI International 2007 at Beijing, China. Once more, the overall response was positive and the game was characterized as "*seriously fun*".

Finally, at the Arcademy Games Awards in Montreal, Quebec, sponsored by Festival Arcadia, "Game Over!" won the People's Choice award. In this event the submitted games were showcased in front of 22,000 visitors.

CONCLUSIONS AND FUTURE WORK
According to the positive feedback received from many alternative sources, it can be claimed that "Game Over!" achieved its design goals, proving that the suggested approach and concept can significantly contribute towards the objective of raising awareness and teaching game accessibility. In fact, there are some educators who are already using "Game Over!" as support material for game development, universal design and accessibility courses. Of course, there is still a lot of room for improvement and future work.

The key feature missing from the game, as was requested by many of the players, was direct, context-sensitive, access to additional background information, such as: (a) the target user group each guideline is indented for; (b) what exactly is the problem and why following the particular guideline can help; (c) in which cases the guideline applies (or not); (d) examples of how the guideline can be applied; (e) reference to published games that suffer from the same problem, and (f) links to related guidelines and sources of more information. In this case, a trivial solution is to add a "Learn more" button next to each guideline.

Another related problem was that the levels intended to showcase the barriers that blind people face (i.e., levels 17-20) were (unsurprisingly) for many people harder to grasp. This can be basically attributed to the fact that most people are not familiar with the way that blind people use computers or play games. A possible solution is, once more, to provide access to additional information and examples, so that players can imagine or "simulate" playing as a blind person. For the time being, in order to temporary remedy this problem, additional information about the gameplay of each level was added to the game's web site.

Then, there was a person – there always is one – that reported that he had found out some tricky ways for getting positive score in about half of the levels, which is something that in general should not happen.

Finally, only part of the available guidelines was covered, and a limited number of examples were provided. This is mainly due to the exploratory nature of the game, but also an unavoidable fact, since it is not possible to showcase every possible instantiation of any guideline through a single game. What is actually needed is to create a "Game Over!" for every alternative game genre.

In this context, future work comprises two parallel paths. The first is to improve "Game Over!" by: (a) enhancing the existing levels based on the comments received; (b) adding new levels and guidelines; and (c) embedding background information and linking to related on-line resources. The second path leads to porting the concept to more popular but also demanding game genres. In this regard, an independent game development studio has already stated its interest in developing a "Game Over 3D" first person shooter.

As a final remark, it has to be noted that this paper does not suggest using games as a substitute for the "traditional" ways and media for teaching and disseminating design knowledge, but as a complementary support tool that increases the awareness and interest of game developers in the subject, while also providing useful, practical information though first-person experience. Also, it should be noted that the suggested methodology is not only appropriate for the games community, but can be more widely used in other domains, such as user interface design.

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