ADOPTING A USER-CENTERED DESIGN PROCESS IN ORDER TO ENSURE MEANINGFUL PLAY: THE SIDEWALK SAVER GAME PROJECT

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1. Abstract

It is well known that designing and developing games is no straightforward matter. It involves a creative design process, as well as software engineering processes. Many postmortems report on the tension between creative processes and large-scale programming concerns. When aiming at ‘meaningful play’, one more layer of difficulty is added. How can one ensure that besides entertaining, a game also affects the audience in the intended way? In this paper we report on the making of Sidewalk Saver, a game with the aim of sensitizing young adults about the accessibility of public spaces for people with disabilities. During the making of this game, we tried to reconcile a creative game design process, a software engineering process and a user-centered design approach. In this paper we report on the intricacies of reconciling these different approaches and the added value of including the stakeholder in the design process.

2. Introduction

The Sidewalk Saver game project was inspired by an initiative from the ‘Advisory Body on Accessibility’ of the city of Louvain, Belgium. One of the purposes of this advisory body is to increase the public awareness on accessibility of public spaces for people with disabilities.
Many people are limited in their mobility when moving around the streets. Among them are people with motor, visual or hearing impairments. But also people who broke a leg, young mothers with a buggy and the elderly can experience certain limitations when walking around. As such, everyone is at some point in his life confronted with problems regarding accessibility. Unfortunately, within the typical Belgian cities, based on medieval patterns, accessibility of public spaces is far from ideal. Especially, the state of the sidewalks tends to be problematic; they are often too high or narrow, interrupted frequently, contain abrupt curbs, and all too often in a poor state. Furthermore, these sidewalks are often littered with carelessly placed bikes and garbage bags (figure 1). As for open spaces such as squares, in the summer, bars and taverns claim the public space to install summer terraces. And although special guiding tiles for people with visual impairments are implemented (figure 2), these tiles are often rendered useless when obscured by bikes, garbage bags or sandwich panels.

Figure 1 – Some examples of inaccessible sidewalks.

Figure 2 – A person with visual impairment utilising guiding tiles.
In order to increase awareness, the ‘Advisory Body on Accessibility’ sets up regular media campaigns. One such example of reaching out to the people was the ‘Save the Sidewalk’ campaign that urged the inhabitants of Louvain to act in a more courteous way to leave the sidewalks and squares free of bikes and other annoying obstacles. As usual, this campaign consisted of flyers and posters. Unfortunately, young adults and adolescents are hard to reach and sensitize with these traditional media channels. Yet, students are a major part of the inhabitants of the city and most often responsible for carelessly placing bikes and other belongings. Clearly, investing in a media campaign is pointless if the target audience is not reached. Therefore, the advisory body came to the idea of using those media that are natural to youngsters. A computer game could inform about the importance of accessibility and might be more successful than traditional print media. When playing this game, players should learn about the issues that people with disabilities face, and players should be made aware of what they can do to prevent these problems. It was with this idea that the advisory body contacted the e-Media program.

**e-Media and the Game Project**

The Master in e-Media (emedia.groept.be) is a specialized program for students who already own a master degree in multimedia, computer science, engineering, or equivalent. The aim of the program is to familiarize the student with the creation of electronic entertainment. The most important part of the curriculum during this one year program is the *Game Project*, a course in which a team of students is required to create a working demo. This project mimics a real world job situation, with team members being responsible for every aspect of the game development cycle, from 2D and 3D content creation to coding, team management and software engineering. The game the students are required to create can be classified as a serious game (SeriousGames.org). Thus, the students are presented with the extra challenge of attempting to tie an inherently ‘fun’ activity (playing a game) to a serious subject. Past examples include a game catered to a senior audience (Abeele et al, 2007), and an educational game for preschoolers (Abeele et al, 2008). For this year, we accepted the challenge of the advisory body to create a game that would sensitize students about accessibility and motivate them to adjust their behavior.

**User-Centered Design in Game Creation**

In order to ensure meaningful play and to create a game that ‘matters’, the students are required to adopt a user-centered design approach. In the field of human-computer interaction,
there is a strong emphasis on user-centered design (Cooper, 2003, Schneiderman, 2003, Preece et al, 2007). A typical user-centered design process is identified by its early focus on users and their tasks, the empirical measurement techniques used to gather user feedback, and its iterative nature. The key idea is that the target audience of a particular software product should be involved in its design. Several degrees of user involvement during the design are possible, ranging from simple user testing to a close participation in the entire design process. The benefits of user-centered design are numerous, both in achieving a more effective and usable product, and in reducing the cost of the development process (Cooper, 2004).

In the field of game creation, user involvement is usually limited (Sykes & Patterson, 2004) to user testing to tune the game to the right challenge, the so-called balancing (Pagulayan et al, 2004). In this case, evaluating and testing a game happens at a time when most of the decisions have already been made by the game designer and his team. Most factors that define gameplay and certainly – meaningful play – are already defined and are not to be changed at this point. Plenty of decisions that should be fed by user research in a user-centered design process are left to the imagination of the game designer. This poses a threat of ending up with a self-referential design process where gamers design for gamers, known as the I-methodology (Gansmo et al, 2003). This is especially dangerous when the target audience of the game differs significantly from the demography of the game’s designers – in such a case, one should consider an even more elaborate user involvement. Ensuring meaningful play requires user research early on in the design cycle. As already pointed out by Kücklich (2004), Salen & Zimmerman (2004), Oxland (2002) and others, users bring their context, their goals, their wishes and their dreams to playing games. Especially when expanding gameplay to mis- or little understood audiences, the importance of this type of user research cannot be minimized.

In the remaining sections of this paper, we explain more specifically how a user-centered design approach was implemented and combined with the creative game design process and software engineering processes when designing and developing the Sidewalk Saver game project.

3. Sidewalk Saver Game Project

The game project required students to utilize a user-centered design process. However, the students quickly realized that the assignment confronted them with an extraordinary situation.
On the one hand, the target audiences for the game were students, like the developers. Thus, the influence of the I-methodology was not seen as a crippling factor, since the developers were in fact part of the target audience. On the other hand, the subject of the game was a very specific group of people, namely people who are restricted in their movements, more specifically individuals with paraplegia or visual impairments. Non-disabled people have difficulties relating to the situation of wheelchair users or visually impaired persons. It is hard for them to understand the problems these people face every day – and this is precisely the goal of the game that was to be developed. Having people who do not fully understand about disabilities create a game to sensitize is like listening to a faithless preacher – it would clearly yield an unconvincing result. Therefore, we decided to inverse the user-centered design methodology and to closely involve the stakeholders instead of the end users, namely people with disabilities. Furthermore, we adopted a participatory design process. Participatory design is a specific user-centered design practice that first emerged in Scandinavian countries in the seventies in the development of work-oriented software applications (Winograd & Kuhn, 1996). The end-user is included as an equal design partner in the design team with direct influence on design decisions (Van Rompaey et al, 2006). To conclude, from abstract stakeholders, people with disabilities became participants in our development process, contributing directly as design partners.

The full duration of the project comprised five phases. In phase one, the development team (which at that point comprised only two students) experienced the issues first hand by means of immersion activities. In phase two, the team cooperated with a group of disabled people to design a basic concept for the game. Phase three consisted of reiterating the design concept, resulting in a detailed design document. Phase four consisted of elaborating this concept and creating a working demo, while phase five entails the evaluation of the final product. We now discuss these five phases in more detail as illustrated in figure 3.
Phase one: Immersion Activities

The aim of the first phase was to increase the empathy of the team with the subject of accessibility. We started out with a theoretical presentation about the issues (figure 3 – 1. Lecture on accessibility by Advisory Body), given by two experts in the field. While this is a necessary step in the empathizing process, it is insufficient: first-hand experience is needed to fully grasp the situation.

A second step therefore consisted in the participation of the team in so-called immersion activities. These are sessions where a non-disabled person gets to experience what it is like to have a certain disability, by moving around in a wheelchair or blindfolded, or with earmuffs, for example. Each of these sessions is guided by one or more individuals with the disability that is being experienced. These people serve as experts, teaching the participants both about the theoretical and practical aspects of living with a disability, such as how to maneuver a wheelchair, how to use a white stick, what to do when an ATM machine is wheelchair inaccessible, how to cross a busy square when visually impaired, etc. Since the game is primarily aimed at accessibility for people with paraplegia or visual impairment, we participated in these two immersion activities.

With the first immersion activity, we spend an entire day within a wheelchair maneuvering around the city (figure 3 – 2. Immersion: what is it like to be in a wheelchair). Two people with paraplegia guided the students around, paying particular attention to problem zones and pointing them out to us (figure 4). To further grasp the day-to-day issues experienced by a person in a wheelchair, we were shown some problems that can occur during seemingly trivial
activities: attempting to inspect the items on the top shelf in a store, paying at a counter designed for standing height, entering a revolving door, maneuvering through a densely populated dining hall, and so on.

The second immersion activity (figure 3 – 3. Immersion: what is it like to be visually impaired), teaching us about living with a visual impairment, followed a largely similar pattern. Both team members were blindfolded, provided with a white cane, and consequently guided around the streets by two visually impaired people (figure 5). During the tour, many issues were presented, such as detecting and using staircases, crossing a busy square, sensing when and how to cross a street, and navigating through a shopping street full of obstacles.

Figure 4 – Immersion activity: identifying with wheelchair users
After participating in the immersion activities, the team had obtained a much better view on the issues experienced by disabled people. However, the episodic nature of these sessions implied a lack of information about long-term, real life situations. The people who had guided us during these sessions were therefore asked to keep a diary for a week, describing the problem areas they encountered in their everyday lives. In addition, a camera to photograph these problems was handed to those able to use it. At a later meeting, these extra pictures and problem zones were discussed.

**Phase two: Brainstorming and Co-designing**

Even though participating in the immersion activities helped greatly in understanding the accessibility issues at hand, it did not make us experts. Therefore, a second stage in the development process of the game consisted of a brainstorm and co-design session with people with disabilities, most of whom had served as guides during the earlier immersion activities. The other attendees were the two student developers, the usability expert, and an administrative helper. Out of the eight people who participated in the participatory design session, one was a wheelchair user, and three were visually impaired.

During the first part of the session, the GPS brainstorm method (GPS) was used (figure 6), this is a structured brainstorm method using themes written on topic cards (figure 3 – 4. *Brainstorming game elements*). Brainstorming took place in pairs of one disabled and one
non-disabled person. It quickly became apparent that brainstorming with visually impaired people has its intricacies… During the second part, two larger groups were formed, each lead by one of the e-Media students. The aim of this part was for each group to design a rough concept of a game (figure 3 – 5. Co-designing game concepts).

The first concept that originated from this session was a first-person view game, where the player would have direct control over a person with a disability. The player would have to lead the character to a certain location, while overcoming several obstacles. The main point of criticism on this concept was how to represent blindness in first-person: a sonar-like, sound-based system was devised, but was ultimately rejected on the grounds of being unintuitive. Only using an avatar with a motor impairment was considered too ‘narrow’ by the participants with disabilities.

The second concept described a game where the player would have a more general overview of the city. Several persons with different disabilities would walk through the city, and come across different types of obstacles. The player would be responsible for removing the obstacles throughout the city, so that everyone would reach their destination safely. This concept was favored over the first concept because of the diversity it offered, many different disabilities could easily be added to the game and the different problems they were facing would immediately appear.
Phase three: the Game Design Document

It is important to address how and if game concepts can be designed by a group within a participatory design process, versus the artistic creation of an individual. Norman (2003) argues in ‘Emotional Design’ that design by committee is a recipe for dull and uninspired design; too many compromises in the group ruin the end result. The same danger is certainly present in the process of designing games with participatory design. The inclusion of the user/stakeholder in the design process does not eliminate the need for a skilled game designer. Quite the contrary, the creative, imaginary and visualization skills cannot be sought after in the end user or stakeholder. It would be a mistake to interpret the result of a co-design session as any attempt to a final design. The game concepts that are co-designed need to be reiterated to improve the game design. Therefore, in phase three, students reprocessed all the information and came up with their own game concept, inspired by but not identical to the previous research activity.

As a next step in the participatory design process, a presentation about this new game concept was shown to those people with disabilities who were present during the brainstorm and co-design. During and after the presentation, a round-table discussion ensued, and several useful additions and alterations were incorporated into the design document. A main concern was the fear of stereotyping and lack of respect, e.g. how to represent the accidents happening to the avatars within the game setting. Was it acceptable to have an avatar be run over by a car? Could an avatar fall from a staircase? Could we employ a cartoon style for such a serious matter? The participants stressed the fun factor within the game. With a touch of humor and the right artistic style, accidents happening to avatars were not seen insulting and simply part of the gameplay. Of course, excessive blood or too realistic scenes were to be avoided, students needed to balance carefully between fun and disrespect. The participants again stressed diversity, not all avatars should have the exact same disability or encounter the same problems. Based on this feedback, the final game design document was created.

The end result of our efforts was a game design document on the game Sidewalk Saver, a name chosen for its similarity with the initial campaign. This design document contained all the necessary information that developers and artist need to go ahead such as the game genre, game story, protagonist and antagonist, goals and rules within the game, game levels, game world, artistic style and game props, game mechanics, etc. In short, the Sidewalk Saver game resembles a mixture of puzzle and strategy,
where a number of pawns are dropped in a city environment. Each of these pawns represents a person with a disability, either someone with a visual impairment or someone with paraplegia. The pawns will autonomously attempt to reach a certain destination in the city, but face numerous challenges along the way. Each of these challenges represents a real world issue, such as a bike or garbage bag which is positioned across a sidewalk, or an altitude difference which is unbridgeable to pawns who use wheelchairs. It is the goal of the player to eliminate these challenges and keep his pawns ‘alive’, by removing obstacles in front of the pawns and using existing techniques such as laying down guiding tiles along the movement path, or bridging staircases by attaching a slope. In this way, players will not only be educated about the challenges faced by persons with a disability, but also about the existing solutions (figure 7), and what they can do to alleviate the situation (not parking a bike on guiding tiles, for example).

![Figure 7](image)

**Figure 7 – A screenshot from an early version of our game, demonstrating the use of guiding tiles to provide direction to people with a visual impairment.**

**Phase four: Development of ‘Sidewalk Savers’**

The actual development of Sidewalk Savers happened during a time span of nine weeks. For the development phase, a team was formed consisting of the two e-Media students, and three students who joined the project at this phase. At the start of the development, an important decision had to be made about the type of development process that would be used. Often, development happens according to a so called waterfall model (Royce, 1970). The waterfall model is a sequential development process that only at the end of the process results in a workable application (figure 8). The principal disadvantage of this approach is that it is hard
for end-users to participate in the development process. They will only be able to see and use the application at the end of the process, which runs contrary to a user-centered design process. Because of the fact that it is difficult for end-users to define their requirements in detail at the start of the project, and the requirements of those end-users often change during the development process, the chances are quite high that an application designed through a waterfall model will not be satisfactory to the end-users. Moreover, changes that have to be made are much more time consuming and costly towards the end of a project.

Therefore, the development was tackled using an iterative approach, as described in the (Rational) Unified Process (UP) (Kroll & Kruchten, 2003). The Unified Process consists of several iterations, each consisting of five steps: requirements analysis, design, implementation, testing, and deployment (figure 9). The main benefit of a UP over a waterfall model, is that a new incremental version of the application is produced at the end of each iteration. Each of these versions can then be user-tested, resulting in possible changes or additions to the requirements. These are subsequently taken into account while developing the next incremental version of the product. This implies that the most important changes in the design can be made in the early stages of the project, when possible changes are the least time-consuming and costly. As such, this ‘unified’ process blends well with a user-centered design process that stresses an early focus on users and rapid prototyping to gather user feedback. In accordance with the UP approach, the project went through the phases of Inception, Elaboration, and Construction.
Inception

During the inception phase, the main focus lay on soft skills, rather than the actual coding or content creation. We defined the team roles, made decisions about which tools to use and set up the team management.

A lot of time during the inception phase was absorbed by setting up the project management. One of the initial two team members was appointed team leader, and made responsible for setting up the managerial infrastructure. Among his tasks were the creation of a wiki for content sharing, writing the meeting reports, setting up a system for timesheet distribution, team communication, and so on. All these activities were related to the development process, rather than creating the product. However, of major importance is how the game design document is translated into a concrete project schedule; which programming priorities should be made, and what essential game mechanic should be concentrated on first (figure 3 – 9. Converting game design document into programming priorities). This schedule was defined in the form of a product backlog and a project plan. The former is a list of formally defined assets that were to be developed, labelled by priority (high, medium, low, and optional). Subsequently, the project plan defines the assets that should be created during the current iteration, the available time span, and the responsible team members. The backlog and the plan were drafted in such a way that the most essential gameplay items were created first, so they could be tested early on and, if required, adapted or even completely redesigned. At the end of each UP iteration, the backlog and the plan were updated based on this evaluation. This approach allowed us to be flexible in the implementation, while still working towards
predefined goals to keep the project on track. Additionally, an intermediate playable prototype is delivered at the end of each iteration, as dictated by the user-centered approach.

**Elaboration**

Next in line was the Elaboration phase, in which the architecture of the project got its basic form. Because of the very limited time available, the team was obligated to utilize tools that permitted rapid prototyping. *Virtools (virtools.com)*, developed by Dassault Systems, was therefore chosen as the development framework. Developing early prototypes is critical within a user-centered design approach (*figure 3 – 10. Creating demo application of basic game mechanic*). Unfortunately, the development team was not familiar with Virtools due to its unusual approach to coding: it employs a graphical programming language that allows the developer to connect several behavioral building blocks to create the game logic. This method totally differs from the object oriented paradigm, which the developers were familiar with (Larman, 2005). As a result, it took quite some time to get acquainted with the Virtools framework, though we are convinced that learning a full-fledged object oriented game engine would have been even more time-consuming. Because no one in the team had any experience with Virtools, scouting and learning the Virtools framework happened in this iteration (*figure 10*). The developers gathered as much tutorials and useful websites as possible to be able to grasp the program in minimal time. It was of utmost importance that this learning iteration was kept brief, due to the limited time that was available before the project deadline.

Fortunately, the chief artist was already familiar with the graphical tools, so he could already start working on a proof-of-concept for the visual style during this first iteration. This involved creating concept art illustrating the characters and environment of the game, and then turning that concept art into usable 3D models. While he was doing this, he taught the other team member that was assigned the role as artist the necessary skills to create some basic graphical content.

At the start of the second iteration of the Elaboration phase, enough knowledge was acquired by both developers and artists to be able to develop a working demo application. In user-centered design and UP alike, it is imperative to present an initial prototype as soon as possible, to discover possible pitfalls early on. Therefore, the developers started working on the basic framework for the game during the second iteration, and created an initial demo application that already incorporated some graphical content made by the artists (*figure 11*). This demo application was presented during a review meeting with researchers of the e-Media
lab (figure 3 – 11. Reviewing demo application with basic game mechanic). The feedback given during this meeting was then processed and used to set the next phase on the right track.

Figure 10 – A screenshot of a basic game resulting from Virtools tutorials. Some of the fundamentals needed for the game are already implemented, but the graphics are almost exclusively placeholders at this point.

Figure 11 – A screenshot of the game at the end of the Elaboration phase. The map layout is now finalized, some graphics have been imported, and additional game logic was added.

Construction

During the Construction phase, the project started to fall significantly behind schedule. Several issues contributed to this. First of all, due to its inexperience in managing a project of this magnitude, the team was too ambitious in drawing up the project plan. It was difficult to estimate how much time would be needed to complete certain gameplay features and 3D models, so the planning was intentionally kept tight, to avoid slacking. Additional
contributing factors were a difficulty in mastering the development tools, and some problems in communication due to the multicultural nature of the team.

As a result of this delay, the initial planning for the second iteration of the Construction phase was reworked to be more realistic, in the hope of pushing towards a representative demo application at the end of the project (figure 3 – 12. Creating playable, representative prototype). Unfortunately, the schedules of the team members did not permit a lot more work to be done, and the final deliverable was less complete than envisioned (figure 12). Particularly, it was not playable enough to be representative of the quality of the final game. Since this is a prerequisite for user testing, an imperative part of any user-centered design method, we decided to extend the project and add an extra iteration to the construction phase, to obtain a more complete version of the game.

Figure 12 – A screenshot of the game at the end of the construction phase. The background is getting filled up with graphical assets, and even logic is added.

Phase five: Evaluation of the game

At the time of writing, the project has just entered the second iteration of the Construction Phase. Hence, we have thus far been unable to evaluate the playability and appeal of our game, though an evaluation procedure has been drafted. We currently aim for a dual evaluation process, where we sequentially involve both our target audience (students) and our stakeholders (people with disabilities). If there is some extra time after these evaluations, the demo will be updated based on the feedback we receive. Otherwise, a report with our findings will be bundled with the proof-of-concept demo, for use during further development of the game.
For the student evaluation (figure 3 – 13. User testing with students), we will organize traditional user testing, where a sampling of students from diverse backgrounds will get to play and comment on the game. A questionnaire will be used, investigating their reaction to different aspects of the game: whether the game balance is correct, their opinion on the graphical style and the control scheme, whether they had fun playing the game and understood the goal, and so on. Special attention will be paid to their understanding of the educational aspect of the game. Students will not be informed in advance that the game is supposed to teach them about disabilities, but part of the questionnaire they fill in will confront them with the real life counterparts of some of the issues in the game, and their understanding of the link between both will be investigated.

For the second part of the testing, involving the people with disabilities (figure 3 – 14. Review with stakeholders), we will use the same collaborators as during inception of the game concept: one or more people with visual and motor impairments, a usability expert, and someone connected to usability initiatives in the city of Louvain. We will present the game to people from the advisory body, followed by an open discussion where everyone can make remarks and possibly express concerns. Potentially interesting feedback will be used to make alterations to the design.

4. Conclusions

The aim of the Sidewalk Saver project was the creation of a demo game to sensitize the student population of Louvain about accessibility for people with disabilities. In order to obtain meaningful play, we tried to reconcile a creative game design process, a software engineering process and a user-centered design approach. Rather than designing with the target audience, as is usually the case, we used participatory design techniques with the people constituting the subject of the game: people with disabilities. These stakeholders contributed directly to the design process, brainstorming an co-designing with the game developers. Yet, we respected the creative design processes that are essential to game design, the game designers had the final call when creating the game design document. In addition, we used a simplified version of the Unified Process to attempt to keep the project on track, focusing on delivering intermediate playable prototypes that could be reviewed throughout the development process.
We conclude that the participatory design was extremely helpful, both at teaching the development team about the issues at hand and at keeping the general direction of the game aligned with the needs and concerns of those involved. We found that the methods which are usually used for participatory design with a product’s target audience mapped remarkably well to our somewhat unusual situation – as long as it is kept in mind that the people participating in the design are not the audience of the game.

The software engineering side of the project, on the other hand, experienced some notable problems. Most of them could be tracked down to the late addition of three team members to the project, causing them to miss the introductory phases. Coupled with an unfamiliarity with the development tools, a significant skill difference between the team members, this led to the project going over time. The use of the Unified Process luckily functioned as a safety net, keeping the delay within acceptable bounds, and allowing us to tweak the process to prevent a complete derailing.

Consequently, we are confident that by the time of the conference and with the addition of an extra development iteration, we will have a presentable prototype, as was originally envisioned.

5. Acknowledgements

We would like to thank the city of Louvain for making this project possible, and particularly Kristel Wildiers who is involved with accessibility and has been the driving force behind the project from the start. In addition, we would also like to thank the people of the advisory body who participated in the immersion activities and co-design.
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