Pervasive Games for Behavioral Change

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ABSTRACT

Pervasive and Serious Games are growing in importance every day. A particular aspect of Serious Games is seriously being explored, Behavioral Change, and with this report, we aim to explore some examples of Pervasive Games for Behavioral Change. For this course, we will give a detailed review of each example, and explore how and if each of them had an impact on the audience.

1. Introduction

Pervasive Games are games that expand into the physical world, and thus are not limited to an electronic device, as a traditional video game. This kind of games break the boundaries of the "video" aspect of the game, and blend with the real world, making use of real life assets to define the objectives of the game. These include, but are not limited to, locations, that when the player is there, trigger some kind of event in the game. Depending on the electronic device, they may even make use of the sensors included, thus making for a richer experience.

Serious Games are games with a strong educational component, which aim to educate or train the audience on a specific matter, by engaging them with an entertainment component, where the progress in the game usually depends on how much the audience knows about the matter, thus making them want to learn, so they can progress further. Some Serious Games also aim to educate the audience into changing a particular kind of behavior, which are called Serious Games for Behavioral Change. They create a set of objectives based on the behavior intended to be changed, only allowing the player to progress if they act accordingly. They usually include some kind of reward in order to persuade the player into acting the desired way.

The object of study in this report is the mix of Pervasive Games with Behavioral Change, that is, Serious Games for Behavioral Change with Pervasive components.

We aim to explore what exists currently in this matter, being it a full game already on the market, or a prototype.

We will analyze some games/projects which we consider enclose these aspects, each with a different theme from the others, and see what they could accomplish in terms of Behavioral Change, and analyze the Pervasive aspect of each.

The objective is to gain insight on what these games can effectively accomplish, what they got right, what they got wrong, where and how they can be improved.

2. Related Work

Regarding related work, only one piece of literature was found, (Gremaud, Pascal, 2013), a report containing the analysis of various pervasive games, also with a focus on behavioral change, or, as they refer to, persuasive games. The main difference is that the related work found focuses only Energy Conservation related games, while we try to widen our scope to everything we can find, and to understand how to build a Pervasive Game for Behavior Change

3. Methods

We began searching for examples of games adequate to our research. The process was the same for each one found:

• Assert the relevance of both Pervasive and Behavioral Change aspects of the game: how relevant and appropriate are both components?

• Balance the previous assertion with the *playability* of the game/project: even if the game is not playable yet, is it interesting enough to include in the research?

Although most examples were found referenced in articles, none of these articles were about this matter, which caused this to be a rather difficult search, because these articles mostly referenced proofs of concept rather than actual products or prototypes.

After finding enough examples, we started analyzing each one. Some of the games aren't playable, as they are works in progress, and others, although playable, are not available or require some special hardware in order to play. So for these ones, we tried to find all related literature, including game documentation, audience experiments and results.

For each game, we analyzed:

• Intended Behavioral Change
• Pervasive Components
• Audience reception
• Audience experiments

- Game Design

4. Results

Each of the following sections will have the result of the research on each game/project found, with a small overview followed by the analysis of the previous mentioned points, if applicable.

5. I-GEAR Project

Starting with the premise that sitting in a traffic jam is lost time and money, the I-GEAR project (Incentives and Gaming Environments for Automobile Routing) intends to explore how one can best channel the motivations of drivers in a way that will optimize traffic flow in Luxembourg. The project specifically addresses problems like government budgets being squeezed, large road infrastructure projects and roadside assistance systems that are no longer feasible, by looking at new ways to change driver behavior through the use of incentives, social networking and pervasive gaming concepts.

5.1. Intended Behavioral Change & Pervasive Components

The game aims to encourage counter intuitive driving strategies such as driving more slowly or taking a seemingly longer route. It will also explore social driving approaches such as car sharing or driving in a platoon (or convoy) to specific destinations. The underlying idea is that people would rather do something else rather than sitting in a traffic jam, but in order to encourage this behavior there is a need to provide them with social, economic or personal incentives. The project raises a number of challenges, which range from identifying the motivations of drivers and relevant incentives though to how to design in-car information systems that do not distract the driver. In order to support these areas the project intends to utilize a contextual design approach that places the driver from the outset at the very heart of the process which will include extensive fieldwork coupled with detailed laboratory and in-situ studies.

5.2. Audience experiments

In the official page of the project it is mentioned that an experiment started on 01/05/2012 with the duration of 36 months. Nonetheless, any results or information related to it are not available to the public.

5.3. Game Design

The main public target of this game are adults who tend to travel on a daily basis with a smartphone. It is also required that the smartphone comes with localization (GPS) and data networking capabilities. The application relies on the concept

of incentives being provided to drivers within a game-like environment. Drivers for example may undertake individual actions such as: giving other drivers priority, taking the slow traffic lane, stopping in designated areas during peak times to reduce congestion, taking alternative routes or car sharing. By encouraging drivers to collaborate and compete through the use of gaming approaches, both individual and social incentives shall be given such as points that can be used to encourage longer-term behavior and discounts for something like coffee.

5.4. Flaws

The main flaw of this project is undoubtedly the fact that it is only focused on Luxembourg. Perhaps if it was extended to other countries a wider set of aspects could be improved.

6. Prof. Tandas Guess A Ware

Prof. Tanda's Guess A Ware is a game that invites players to reflect on their environment and the impact they have on it. It involves a series of quizzes and activities during which players learn about their environmental footprint and find ways to reduce it.

6.1. Intended Behavioral Change & Pervasive Components

The main goal of this project was to develop an interactive mobile phone-based game that collected both environmental and location-based data on the users, in order to provide relative information on their environmental footprint and persuade them to alter their habits to more environmentally friendly ones. There also were other goals such as investigation on how to develop and deploy large scale, mass-participatory pervasive systems; evaluate where, when, and why people play; examination of user behavior and attitude towards persuasive games. The game aims to give advice to raise the players' awareness about their carbon emissions suggesting activities and games which will actually reduce them.

6.2. Audience reception

The game was praised and recognized as fun and interesting for giving advice on several aspects that most people neglect in a different and funny way through Prof. Tanda odd character.

6.3. Audience experiments

The project was a 2 phase 4 year project. The first phase was concerned with the development, trialing and evaluation of the application, while the second phase was used as part of a larger television led campaign with the general public taking part. The first phase of the project took place in February 2007. It was trialed by 30 players for two weeks. In general, they reported enjoying their interactions with the central character in the game,

especially the way in which it engaged them in local activities, an aspect of the game that they would like to see extended in future versions.

6.4. Game Design

The game consists on a character called Prof. Tanda which resides on the mobile phone that interacts with the player in activities such as answering questions in a quizz, performing tasks or doing some activity with the people you are with at the time. This character speaks through speech bubbles, combines serious questions with playful ones and shows interest in the players opinion on the most diverse topics. The game also stores data about the player so that it can be used to provide a better interaction with the game.

6.5. Flaws

During both the development and trial of the game, several thoughts about the pervasive games in general occurred, such as: How to encourage mass participation? What are the most appropriate mechanisms of inducing fundamental behavioral change? How can a game be created that becomes part of everyday life that relates to the user's behavior and where would the game fit into the larger project if a campaign was to be run? These questions remain unanswered to this day.

7. MASELTOV

The project MASELTOV consists on the development of a mobile service for continuous assistance and investigation of the influence of pervasive computing on the individuals motivation for learning. With the concept of applying digital games, mobile context awareness, and social computing to motivate local community building, to connect immigrants with native citizens and vice-versa, in order to foster communication and bridging of cultural differences.

7.1. Intended Behavioral Change & Pervasive Components

The application aims to implement serious games for behavior change in the context of human-human interaction, a holistic approach is needed that takes into account behavioral cues from multi-sensory input, possibly including speech, video (facial expressions and gestures), and physiological sensors. These sets of games within the application are intend to improve language understanding, local community building, consciousness and knowledge for the bridging of cultural differences,and finally foster employability.

7.2. Audience reception

The game is highly praised and recognized as an excellent learning tool for anybody who wants to learn a foreign language anywhere in the world. Also the application provides a chat and forum that users can use to help each other.

7.3. Audience experiments

An experiment took place in England where 17 Spanish speaking immigrants with little to no experience in English experimented with the application for 3 weeks, being the forum moderated by a Spanish speaking facilitator who encouraged interactivity. In the end of the trial, results show that the forum was used extensively by many participants and was an important tool in helping to create a sense of community of learners.

7.4. Game Design

MASELTOV embeds an easily scalable context recognition framework that receives contributions from various context feature generating services; it evaluates the user behavior and from this, maps to appropriately motivating actions in the form of recommendations. From long-term dialogue assessments with multi modal mobile context awareness on the basis of affect and attention sensitive services it classifies the language learning behavior of the recent migrant. The recommender system then instantiates according to the individual human factors profile and the measured performance personalized motivating games, in order to change the behavior of the user. For example, to reinforce the training on interaction with local citizen, the rewarding of dialogue supporting activities will be increased, such as, by doubling virtual credits in return for dialogue specific language learning and measured communication in shopping scenarios.

8. Habitat

In the style of the good old *Tamagotchi*, in this game you take care of a "pet" polar bear. The objective is to keep the endangered animal alive, as its habitat is in danger. The player is given some tasks that, if completed, increase some of the pet's stat points, and give the player "Eco Coins", an in-game currency that can be used to buy special in-game items. These tasks consist on simple mini-games in-app, and on simple ecological activities, such as turning off lights to save energy, or reducing the time spent in the shower. Although it has no direct method for knowing if the tasks were truly complete (it asks the player to manually input), we must take into consideration that it is a game for younger audiences, and can be "monitored" by teachers or parents, which can make sure the children really do complete these tasks, and the fun factor of the game can also easily persuade them into actively participating in these activities.

8.1. Intended Behavioral Change & Pervasive Components

The game aims to encourage the audience, children mainly, into being more careful with the resources they spend, energy, water, and such, rewarding them accordingly to how they respond to this intended change, that is, the more wary the children are with the resources they spend, the better the reward they get.

The main tasks the game gives the players are household related activities, or missions, such as spending less time in the shower, turning off lights. As mentioned before, these measures are not directly taken, so it is up to the player to complete the objectives. The game also features a *pin* collecting and trading system, depending on the player's location.

8.2. Audience reception

The game is highly praised and recognized as an excellent learning tool for children, and was even nominated for the *iKids* Awards for Best Learning App (Habitat Wordpress, 2014).

8.3. Audience experiments

No specific documents regarding any kind of social experiment with this game were found, although on the game's website, several outdoor propaganda activities are referred.

8.4. Game Design

The game is set in a glacial environment, and is presented in appealing 3D graphics. The first thing the player sees when starting the game is the cute playful pet polar bear, instantly forming a bond between the player and the pet. The player is then encouraged to explore the game's UI, leading to the discovery of missions and other content. The UI is simple and objective, so it lets the player focus on the game itself rather than having to spend a lot of time learning how it works.

8.5. Flaws

The main flaw is the mentioned lack of direct measure of the proposed missions' objectives, so it assumes the player's honesty. In the end, we do not consider this such a bad thing, because the expected change in behavior has to come from the player's initiative.

9. ASC-Inclusion

The ASC-Inclusion project aims to create an internet-based platform with the purpose of assisting children with ASC (Autism), and those interested in their inclusion, in order to improve recognition and expression of socio-emotional cues.

9.1. Intended Behavioral Change & Pervasive Components

The project combines several state-of-the-art technologies in one comprehensive environment, including analysis of user's gestures, facial and vocal expressions, training through games, text chatting, animation, video and audio clips. The games environment is personalized having in mind individual skills and challenges, sensory requirements, and increasing motivation through special interests. The game aims to help children with ASC improve their expressive emotional repertoire (facial expressions, vocal intonation, body language and vocabulary), emotion recognition skills, social skills and adaptive behavior at home and in school. It also intends to improve both parents socio-emotional awareness and socio-emotional mediation skills and general motivation and interest of children in socio-emotional phenomena.

9.2. Audience reception

In general, children liked the activities available in the game and were able to enjoy playing it, while the platform gathered data, analyzed it, and tried to improve the users performance.

9.3. Audience experiments

Several experiments were done, mostly in the United Kingdom, Sweden and Israel. Results reveal significant improvement of the children with ASC regarding social interaction and emotion recognition tasks. Reviewing system logs also shows that the system was able to recognize up to 80% of children's expressions.

9.4. Game Design

The project relies on a platform that communicates with an Emotion Agent that gets the current emotion which the player is having from the analysis of the input from sensors (webcam, microphone, etc), thus involving face, voice and gesture analysis to gather data to interact better with the user. This information is used to determine what aspects of the user need to be improved and how the development of this aspects is occurring through time, since the platform saves the data in logs for later use. This feedback also helps to specify the user requirements of the virtual environment and to design accordingly the computerized therapeutic intervention.

10. Building a Pervasive Game for Behavior Change

We can see that there is not only one way to build a Pervasive Game for Behavior Change. It depends on so many factors, that we think no two games can feel the same. In this section, we will present some points on how a Pervasive Game for Behavior Change can be created.

(i) **Target audience.**

- Like in any game, the target public should be very well defined. This is even more important for this kind of games, as the learning and pervasive components will very much depend on this

(ii) **Game Design.**

- Game play, story, characters, mechanics, etc. Any component in a typical game should, if applicable, be very well defined in this kind of games. The engagement of the player comes mainly from these points.

(iii) **Learning components.**

- The educative objective should be appropriate for the audience. For example, children will have a very hard time learning about more advanced scientific topic, and environmentalists surely (or at least they should) know about recycling and energy saving. These are merely examples of inappropriate educational material for a determined target audience, but the point is that the the learning component has to be suitable for the target audience.
- The Behavioral Change component is probably the most complex of all, and requires a lot of effort. This process must be coherent with the Game Design process, because the expected changes will most surely come from the engagement of the player in the game, that is, the game must make the player want to demonstrate the desired behavioral changes. Although rewards and incentives can be an efficient way to persuade the players into acting in the desired way, we think that the game as a whole should be the big payoff, that is, the player should want to change because the game makes him want to do it, as in, engagement, story, the main components of a game design, and not just because of competition, as in rewards and leader boards.

(iv) **Pervasive components.**

- Like the previous point, this component should be appropriate for the target audience. Younger audiences cannot be expected to perform tasks only an adult can do, or even travel to places they simply can't. Although many games in this context usually ask for the help of a tutor (parent or teacher), this point should still be addressed thoroughly, as even the engagement of the player can depend on this
- Pervasiveness should expand the game, and not become it. What makes a pervasive game fun is the interaction between both a device and the real world, because without the device we are limited to our surroundings, but with it, being a smartphone, a tablet or any kind of day-to-day useful gadget, greater experiences can be developed, but the game should not be so fantastic that the pervasiveness would be limited to very very simple tasks, such as going to a place and adding some score.

Although these points are common between all the projects, the approach is always different. Different themes have different scopes, and thus, a more detailed guideline cannot be produced. Some projects may require different specialists, for example, a doctor for a medicine-based game, a psychologist for an emotional approach, a teacher for an educational game. In (Kelly, Henry, 2007), the author describes the process of building a serious game. The game described has the objective of teaching students about immunology, and the team includes members various, different, disciplines. Some were proficient in game design/development, and others were specialists in immunology. This example shows us that game design and development skills, with some insight on the matter in question, are definitely not enough for the development of this kind of games, but rather, an interdisciplinary team, with constant inner communication, is fundamental for a good experience and fulfillment.

11. Conclusions

The analysis of these examples gave us a much needed insight in the matter of Pervasive and Serious Games, specifically on the Behavioral Change aspect. It is certainly a subject of high interest, although the exploration has only recently just begun. *Habitat* shows a great potential for behavior change demonstration, and is a great example of how a game can be entertaining and educational at the same time.

The process of building such a game is not a linear one, and has to be though of thoroughly. The points gathered in the previous section where the conclusion of the analysis of the presented games/projects. They are our reflection about how the development of this kind of games should be approached.

References

Koenig, Vincent, Franziska Boehm, and Rod McCall. "Pervasive gaming as a potential solution to traffic congestion: new challenges regarding ethics, privacy and trust." Entertainment Computing-ICEC 2012. Springer Berlin Heidelberg, 2012. 586-593.

Luxembourg, U. (n.d.). I-GEAR. [online] University of Luxembourg. Available at: http://wwwen.uni.lu/snt/research/netlab/projects/i_gear.

Rodmc.com, (2012). I-GEAR Project Starts Watch Out Drivers in Luxembourg — Rod McCall. [online] Available at: http://rodmc.com/?p=141.

Schuller, Bjorn W., et al. "Serious gaming for behavior change: The state of play." IEEE pervasive computing 3 (2013): 48-55.

Open.ac.uk, (2015). MASELTOV Project Blog — Just another WordPress site. [online] Available at: http://www.open.ac.uk/blogs/MASELTOV/.

Open.ac.uk, (n.d.). MASELTOV — Institute of Educational Technology — Open University. [online] Available at:

http://www.open.ac.uk/iet/main/research-innovation/research-projects/maseltov.

Habitat's Digital Chalkie, (2014). Australian environmental app Habitat the Game nominated for iKids Award 2015. [online] Available at: https://habitatthegame.wordpress.com/2014/11/28/habitat-is-nominated-for-ikids/.

Gremaud, Pascal. "Pervasive, Persuasive Gaming for Energy Conservation."

Schuller, Bjrn, et al. "Recent developments and results of ASC-Inclusion: An Integrated Internet-Based Environment for Social Inclusion of Children with Autism Spectrum Conditions."

Schuller, Bjrn, et al. "ASC-Inclusion: Integrated Internet-Based Environment for Social Inclusion of Children with Autism Spectrum Conditions." (2013).

Kelly, Henry, et al. "How to build serious games." Communications of the ACM 50.7 (2007): 44-49.