

Designing Meaningful Game Experiences for Rehabilitation and Sustainable Mobility Settings

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Abstract

This paper presents the approach followed in two ongoing research projects aimed to designing meaningful game-based experiences to support home rehabilitation, eco-sustainable mobility goals and more in general better daily lifestyles. We first introduce the need for designing meaningful game-based experiences that are well-connected to the relevant non-game settings and can be customized by/for users, then, we show examples of how this approach can be realized in the rehabilitation and sustainable mobility contexts.

Keywords: Home Rehabilitation, Sustainable Mobility, Persuasive Technology, Gamification.

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1. Introduction

This paper reports recent work conducted in the context of the REHAB@HOME and SUPERHUB European projects [4, 5], where we are deploying user-centered design methods to understand how to realize meaningful game-based experiences for rehabilitation and sustainable mobility purposes. As reported also in [5, 8] the concept of putting the user at the center of a gamification or game design process is key to realize meaningful, effective experiences for users and achieve behavior change goals [2]. Meaningful game design for behavior change is more challenging to achieve, if compared to the design of digital games for leisure, entertainment contexts where game rules and patterns can more easily and effectively applied. In meaningful game design for non-leisure contexts game elements need to be derived from aspects of the underlying activity that are meaningful to the user.

Previous work has shown that providing only external rewards to motivate change might not be enough to produce the desired outcomes, nor be an ideal solution [1,4,5,8]; instead, providing clear connections between the game elements and important aspects of the relevant non-game

activity (as well as user's own goals and desires) can bring more benefits and stable outcomes. Also, since users have different needs and preferences, another design challenge consists in providing a flexible gaming environment that can be personalized and customized to meet individual needs and be perceived as meaningful by the different target users. In the following sections, we discuss how these design principles and challenges are being addressed in the two design scenarios of REHAB@HOME and SUPERHUB.

2. Game-based Rehabilitation Scenarios

The REHAB@HOME project [6] aims to develop an innovative, effective game-based rehabilitation solution for patients with motor-cognitive impairments (e.g., related to stroke, Multiple Sclerosis, Parkinson disease) in order to increase their compliance and motivation to follow rehabilitation programs at home.

The project aims at integrating state-of-the art, low-cost gaming platforms, such as Wii, Kinect, LeapMotion and Sifteo Cubes (Fig.1) together with sensor-based collection of relevant patient data and personalization, to provide an enriched, contextualized serious-game based environment where patients can exercise individually or connected with

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other patients through social networks. Therefore, the project aims at transforming the patient's home into a place, where physical and cognitive rehabilitation processes can be performed in an intensive, engaging and professionally guided way, while promoting social inclusion and quality of life.

During the first 6 months of the project, scenario-based interviews with 10 patients visiting Fondazione Don Gnocchi rehabilitation center (Milan, Italy) were carried out to better understand patients' requirements and expectations regarding the technological solution to be designed. From the data collected two main indications for the design of the game-based solution were derived from patients:

- a) the platform should be easy-to-use and set up, propose exercises and movements (to achieve the game objectives) that are closely related to Activities of Daily Living (ADL), meaningful from a user perspective;
- b) the game solution should be personalized to the specific needs, impairments, preferences of a user and provide a clear feedback regarding the correct execution of movements and patient's progress overtime.

Interviews conducted with 5 therapists at the rehabilitation center confirmed that the kind of information that should be provided to patients during home rehabilitation are few and very clear indications on frequency of exercise execution, correct execution and level of effort required to achieve a specific goal in the short term. Patients should also be provided with advices regarding healthy behavior, the organization of their home environment (e.g. in order to remove physical obstacles), they should be motivated to be active and exercise also beyond the therapy program. It is also important for the system to indicate what the patient should and shouldn't do, such as stopping when it is more painful and which exercises are appropriate for a patient and which are not. In addition the therapists mentioned therapy target that identifies the reason for exercising as part of the information a patient should receive. Overall, therapists were positive towards the use of these new technologies for home rehabilitation since, if properly designed and tuned to patients needs, they could provide a more effective way of exercising and (self)-monitoring patient progress within a stimulating and engaging therapy environment.

Based on these users' and clinicians' suggestions we are now in the process of developing a first prototype solution of the gaming environment for a pilot experimentation, by focusing on supporting rehabilitation of the upper body through exercises that can be easily matched with ADL, like reaching out for home objects and moving them to specific places, making fine-grained movements with one's fingers like it is required by playing a musical instrument.

The game-based solution will also be modular (different games will be made available over time), highly flexible and personalized according to patient needs (e.g., range and intensity of movements required to play will be made easy to calibrate by the patient or therapist before and during the rehabilitation program). Game scores and audio-visual feedback will be designed to allow an effective monitoring of correct execution of the target movements and to provide

information on progress achieved in order to sustain patient motivation over time.



Figure 1. Sifteo Cubes low cost gaming platform

3. Game Experiences for Sustainable Mobility

In the SUPERHUB project [7] we are developing a citizen-center open platform to support multi-modal urban mobility, by deploying also persuasive technology and personalized journey planning services to facilitate the adoption of more eco-friendly travel choices by users.

Among the different persuasive strategies and services designed to fit the several user profiles and support behavior change [2], we have developed also a serious game, named Eco-Dealers.

Focus groups conducted in Milan before designing the game, showed that participants thought that a game should be location-based and realistic, allowing the user to do something during travel time (not only when at home). The game should also provide relevant feedback and concrete rewards (e.g. public transport discounts), educate and inform users about transport systems in the city, support users with simulations, include competitive elements and show how the user's behavior impacts their environmental footprint. To ensure players' engagement it should also link actions in the real world with effects in the game environment, be aligned with real-time information about traffic and transport, present specific game scenarios for tourists (e.g., treasure hunt games related to tourist guides) and be fun.

Based on these users' indications we designed a first prototype of the Eco-Dealers game that is currently under evaluation in several cities in Europe (e.g., Milan, Trento, Bari, Barcelona and Helsinki).

The game concept consists in a gang of traffickers that move inside a city in a sustainable way, by using public transport, with the aim of carrying out secret missions and earn eco-money. This purpose has to be achieved by minimizing as much as possible travel time, traffic and pollution in order to save precious Oxygen-points (O-points).



Figure 2. EcoDealers mission based game

After registration, users can join the Eco-Dealers gang and look for available missions to carry out and select one of them. Every mission, to be completed, requires travelling physically across the city, to collect virtual objects with a mobile device provided with GPS sensors (Fig.2). There are two main ways to carry out a mission:

1. By travelling by tram, bus, metro, etc. and collecting objects as required by the mission.
2. By searching (within the Eco-Dealers network) for supporters who normally or occasionally travel along the routes relevant to a certain mission or part of it. In this case the player needs to make an offer to the potential helper/supporter, who can accept, refuse or raise their offer. A user can earn eco-money by completing missions or helping other users to do so. At the game start, players receive a bonus corresponding to 100 “eco-money”. They can earn more money by completing their own mission or part(s) of other user’s mission (Fig. 3).



Figure 3. EcoDealers rewards for mission completed

Eco-money is a sort of virtual reward, which could be used by players to get real discounts (e.g. for public transports, eco-restaurants or stores, museums, etc.). Also, when starting the game a user is given a certain amount of O-points, which are vital for the player’s survival. Every time users travel and earn eco-money by completing missions as ‘owner’ or ‘helper’, they can also lose O-points if they travel in unsustainable ways (e.g. by using private car). When the O-points are finished, they can be regained in different ways, for example by spending eco-money. The game will provide a tool to help the owner of a mission to find the best journey(s) in order to save money, travel time and reduce carbon footprint. The same tool will also help to find supporters for a mission, searching through the journeys that have been offered. The current version of the game is based on a stand-alone client-server app that can work offline and resynchronize with server when possible. As can be derived from the game description, the Eco-Dealers game provides an example of design of meaningful game-experiences for sustainable mobility, where citizens

can easily find realistic connections with the relevant non-game setting (in this case players can learn more about the public transport offers in a city, the impact of their travel choices in terms of carbon footprint). Players can accept or offer missions according to their needs and preferences, share a mission in order to find similar players, which can be a meaningful result of the game experience. Therefore, there is the potential for design to add further opportunities of engagement with the game and the sustainability goals (e.g., the player could become an activist and start new eco-initiatives in a certain area of one's city). With respect to other sustainable mobility games recently proposed [3], Eco-Dealers offers a more engaging, meaningful and contextualized gaming experience that is more likely to produce enduring learning and behavior change effects.

Conclusion

This paper has presented initial thoughts from the user-centered design of game-based experiences for rehabilitation and sustainability purposes that are currently in progress. In both research projects presented results from the user requirements investigations showed that the game experiences to be designed need to be perceived as meaningful by end users, as well as easily connected with the non-game settings where desirable behaviors need to be adopted and maintained (e.g., patients compliance with home rehabilitation therapy, citizens' eco-friendly travel choices in daily urban areas). We have also presented two examples of how these meaningful and customizable game experiences can be realized in the research fields addressed. Our future work will be focused on iteratively testing and improving the game-based solutions described to better fit their end users' needs, as well as to inform the future design of persuasive technology for healthy living and wellbeing.

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