Diabetes City: How Urban Game Design Strategies Can Help Diabetics

Martin Knöll

University of Stuttgart, Institute of Modern Architecture and Design (IGMA),
Keplerstrasse 11, 70174 Stuttgart, Germany
martin.knoell@gmx.de

Abstract. Computer Games are about to leave their "electronic shells" and enter the city. So-called Serious Pervasive Games (SPGs) [1] allow for hybrid – simultaneously physical and virtual - experiences, applying technologies of ubiquitous computing, communication and "intelligent" interfaces. They begin to focus on non-entertaining purposes. The following article a) presents game design strategies as a missing link between pervasive computing, Ambient Intelligence and user's everyday life. Therefore it spurs a discussion how Pervasive Healthcare focusing on the therapy and prevention of chronic diseases can benefit from urban game design strategies. b) Moreover the article presents the development and work in progress of "DiabetesCity" - an educational game prototype for young diabetics.

Keywords: Ubiquitous & Pervasive Computing; Pervasive Healthcare; Urban Design; Serious Games; Medical Documentation; Diabetes Care.

1 Introduction

Diabetes is a chronic disease likely becoming a major epidemic in the developed countries. Today 200 million live with the disease and the World Health Organization (WHO) predicts an increase to 350 million diabetics until 2025. Type 2 diabetes, which comprises 90 % of the diabetes cases, is largely the result of excess body weight and physical inactivity. Moderate changes in lifestyle, an adequate diet, more physical activity and loss of weight positively influence the therapy of type 1 and type 2 diabetes.

Documenting daily medical data is one essential part of this education. So far diabetics collect their data in so called "diabetes-diaries". These hand-written diaries are the basis for a discussion between the doctors, diabetes-assistants and the patients in order to improve the therapy set up.

Digital documentation tools, for example applications running on a mobile phone or a personal computer are already available, but hardly accepted by diabetics. Further more the documentation is mainly focused on medical aspects only. Even if the positive effects on diabetes by a sound lifestyle, e.g. healthy diet and physical activity, is proven by many studies, there is no documentation tool available so far, that detects the connection between the medical data and the daily personal behavior.

By combining strategies of Serious Game Design with Pervasive Healthcare young patients should be motivated playfully to document their relevant data. The development of the prototype for a Medical Pervasive Game presents urban design research as an interdisciplinary working field. Addressing the relationship between urbanism and healthcare, it seeks to formulate a potential involvement of urban planners in the "design process" of prospective public healthcare projects.

2   How Ubiquitous Computing Evolves into Pervasive Games

"The most profound technologies are those that disappear. They weave themselves into the fabric of everyday life until they are indistinguishable from it." [2]

This famous quote by Mark Weiser gave birth to the expression of "ubiquitous computing" in 1991. Back in the 1980s Weiser identified two main issues of ubiquitous computing: 1.) The scale of microchips and 2.) The ability of microchips to localise. The second in particular is important in order to extend ubiquitous computing to the dimension of an "ambient intelligence".

Ambient intelligence environments, which so far are restricted to buildings and houses, combine "three recent key technologies: Ubiquitous Computing, Ubiquitous Communication and Intelligent User Interfaces." [3]

The invention of global positioning systems (GPS) and their availability in small, mobile devices enables an adaptation of intelligent ambience environments to the whole space of our cities. This is an important point for pervasive healthcare, because patients' everyday life does not only take place in the boundaries of the flats and houses they are living in. But what are the prerequisites for a so-to-call "intelligent ambient city"?

At this point game design seems to be one missing link in the field of human-machine interaction. By conceiving and defining rules and structures that result in experience for players, the design of the *game play* becomes an interesting tool of designing the actual use of technology, in our case: parts of the medical therapy. We have to keep in mind this idea when we talk about projects for chronic patients, who often have to integrate plenty of medical "gadgets" in their everyday life.

3   Serious Games and Pervasive Healthcare

The term "serious game" has been defined by the "Serious Games Initiative" founded by the Woodrow Wilson International Center for Scholars as digital games with non-entertainment purposes such as health care, security, management or learning in 2002. Since 2004 the sub-group "games for health" focuses on "the impact games and game technologies can have on health care and policy."[4] Current trends include video games for rehabilitation and therapy issues and the emerging field of "Exergaming", motivating players for more physical activity.

Developing an educational game for chronic patients like diabetics we seek for game design strategies, which integrate the *gameplay* into the everyday life of its players. A new generation of computer games, called "Serious Pervasive Games" therefore overlay the physical space with a virtual game zone. "They [pervasive games] not only serve as

a new type of gaming, but also as a new form of using and experiencing the city. In pervasive games the city transforms into a playground that can be played every time and everywhere. And this functional assignment does not depend any longer on the building structures but on the available technology."[5] Several prototypes for Serious Pervasive Games (SPGs) have been developed in the fields of health care, security, tourism, management or learning in the last ten years. [6]

The first pervasive serious game that focuses on "the relationship between art, technology and health" is the *Mixed Reality Game* "Ere Be Dragons" by Active Ingredient at University of Nottingham in the UK. "The player wears a heart rate monitor, and inputs his or her age into a pocket PC." An optimal heart rate is calculated and the player starts to walk where ever or however he or she wishes. During the walk an on-screen landscape is built, which uses GPS and corresponds to the real environment surrounding the player and his or her measured heart rate. If players do well for example, adequately exercising their hearts, the landscape flourishes, "while overexertion leads to the growth of a dark, forbidding forest." [7]

Apart from that scientific and artistically approach, doctors and managers in the public health sector begin to see that healthcare is no longer restricted to the hospital or the clinician's practice. Researchers use new technical possibilities and the growing interest of users in collecting private physical data. The Aarhuis-based "Centre of Pervasive Healthcare" (CfPH) works on several case studies for a so-called "HealthyHome". [8] Pervasive Healthcare provides a technical and mental support for patients in their living space in special situations (e.g. for the period of a pregnancy, for elderly or isolated people).

The research on Medical Pervasive Games (MPGs) works on an extension of the user's action-field from the scale of a "healthy home" to the scale of the city and therefore to support patients in their everyday life environment. MPGs seek to develop the potentials of serious games for the education and motivation of people in prospective healthcare and prevention projects.

4   Prototyping a Game for Diabetics

The MPG for Diabetics is aimed at insulin-depending young people with type-1 and type-2-diabetes. It is a prerequisite for the game that users are sufficiently introduced into the basic knowledge of their disease by doctors, nurses and diabetes assistants. In general, patients receive the first brief at the beginning of their disease. Patients learn under clinical circumstances how the disease affects their body, when and how much insulin they need and what an appropriate diet should look like. Patients are instructed how to use their personal technical aids, such as insulin pump or pen, the measurement system and how to do documentation of all the important parameters.

After this period the patients return to their everyday lives facing its complexity of requirements and possibilities. The patients often realize that their therapy was adjusted under the so-called "white-coat-effect". In this point the MPG can support patients as an extension of the clinical introduction into their everyday routine. We focus on children and young adults with diabetes, because in their situation it is of particular importance to combine an active lifestyle with a well-adjusted diabetes treatment to avoid the long-term complications of the disease.

4.1   Objectives – The Spatial Diary

The MPG aims to stimulate a "Spatial Diary", which extends the medical documentation to the factor of the "City". Because the positive effect of lifestyle factors on diabetes is proven, aspects of patient's every day life in their every day environment should be considered in their medical documentation. With the implementation of Serious Game Design, a new strategy of motivation and education should be applied to the therapy of chronic diseases. The Medical Spatial Diary should help to visualize deeply inscribed behavior, such as physical inactivity, stress or inadequate nutrition - factors, which have a grave impact on the patient's sugar levels. As a result the Medical Spatial Diary could serve as an active therapy tool. Patients and doctors are able to discuss therapy and behavioral improvements on a visual basis combining the medical data with the daily activities and their environments.

4.2   Medical Game Design Concept

Therefore our institute develops the serious game design concept "DiabetesCity - Collect Your Data". Children and Young People with diabetes are playfully motivated to document as much as possible of their medical data in their everyday life for a period of 1 week. Early stages of the game design concept provide teams of two players seeking to find and to reveal certain points of interest in the City of Stuttgart. Each team consists of one boy or girl with diabetes and one of his or her friends. The two player receive a camera phone and GPS-featured glucose monitoring system when starting the game. The teams get hints by solving puzzles and doing small exercises - e.g. by interacting with the system.

   The more data the diabetic collects, for example by measuring his or her blood sugar levels or taking pictures of an activity, the more question marks on the virtual maps are deleted and turn into "place marks" of the Spatial Diary. The non-diabetic partner can achieve details for the team by answering questions about the disease. By including this feature we hope to encourage social interactivity between the players and to improve mutual understanding between "patients" and their entourage.

4.3   Realisation / Work in Progress

Urban Game Design strategies as interactive storytelling and community-based communication between users shall be applied on "DiabetesCity" in order to motivate the kids. For the game design concept we work closely together with the doctors from the Centre for Diabetes Care and Education at the Olgahospital, Stuttgart. Currently we are presenting working-models and mock-ups of the prospective game in very early stages to the kids and the future end-users. Pervasive Games can be simulated and prototyped as "augmented" board games. The early involvement and participation of the patients and "players" is an essential part of the design process.

   In cooperation with mobile computing scientists we are working on an interconnection between a standard blood glucose monitoring system, GPS based positioning and the camera of the mobile phone. A standard GPS receiver (65 x 46 x 17 mm) for example can be attached to the medical device and is tracking the GPS

coordinate of its user every 2 seconds. Date, time and position are saved on an in-built flash memory program and can be read into the PC via Bluetooth or via USB wire afterwards.

Data of the glucose monitoring system and the camera phone can be transferred the same way. The main item therefore is the development of an application that combines data retroactively, for example every night. As a result of this procedure the data of the three devices (blood glucose level, position and picture) can be imported to an internet-based "earth browser" such as Google maps or Google earth. Users just connect their "gadgets" to PC and open his or her earth browser. The application easily pops up with some of the common "place marks" providing information about time, measured glucose level and the activity illustrated by a picture or a remark. These "Spatial Diaries" can be shared with other players or the doctor. They build a visual basis for optimizing diabetes therapy and making suggestions for changing lifestyle factors for the patients. Therefore they work as an extension to the existing diabetes management systems.

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