

# Designing a Gamified System to Support Cancer Patients' Recovery

Salvador Moreno<sup>1</sup>, Miguel Damas<sup>1</sup>, Hector Pomares<sup>1</sup>, Jose A. Moral-Muñoz<sup>2</sup> and Oresti Banos<sup>3</sup>

<sup>1</sup>Dept. Computer Architecture and Computer Technology, University of Granada

<sup>2</sup>Dept. Library Science, University of Granada

<sup>3</sup>Telemedicine Group, University of Twente

smoreno94@correo.ugr.es, {mdamas,hector,jamoral}@ugr.es,  
o.banos1egran@utwente.nl

**Abstract.** This is intended to be the abstract of a proposed gamified system for helping patients with cancer in their recovery, to be fully exposed at the IWBBIO 2016. The system, still in development, will gather relevant biomeasurements for clinical purpose via different sensors such as photoplethysmogram (PPG), accelerometers and gyroscopes to keep track of the patients' evolution in his recovery. Besides, it will enhance the patients' recovery using gamification techniques and providing feedback to leverage their motivation.

**Key words:** mHealth, telemedicine, gamification, cancer, smartwatch, health coaching.

## 1 Introduction

According to the World Health Organization, cancer is the plague of the XXI century. It has become the major cause of mortality and morbidity, with 14 million new cases and 8 million deaths related to cancer in 2012, affecting all the regions over the world. These figures are expected to keep growing during the next years [1].

One of the keys for successful cancer treatment is to face the disease as soon as possible, not only by regular medicine, chemotherapy and radiotherapy, but also by empowering the patient's self-determination and fighting spirit [2].

Gamification has been proven as a successful method for behavior change and learning in properly designed systems [3]. There are just a few implementations in the literature that apply gamification to cancer patients such as INTERACCT [4] or Sick Kids Pain Squad [5], but they primarily focus on child treatment, hence a broader age-range gamified application with biomonitoring is proposed to fill in the gap found.

## 2 System Objectives

The main objective is to improve the recovery of cancer patients using gamification. The use of game techniques along with a complete set of biomonitoring sensors will be used to leverage both extrinsic and intrinsic motivation from patients.

The system aims to create an experience to take patients away from the worst part of beating cancer. This will be, in some way, a private and exclusive experience where only patients and medical staff will take part in. Thus, a sense of relatedness and confidence will be provided to each member as a part of this community.

The application will also deliver a sense of empowerment and autonomy for every patient. One of the keys to enhance the intrinsic motivation of patients is to give them back some control of their treatment [6]. Just waiting for diagnoses and analysis can be very harmful in a psychological way, so the gamified app will highlight all the achievements made by the patients on their own, such as fulfilling the quest given or remarking on the physical activity made during a day.

It is important to promote physical activity and interaction between patients. This gamified system will make the most of quests and missions by encouraging patients to stay in touch, virtually and physically, in a game-like environment. All of this will provide the system with the quintessence of every game: fun. In the end, fun is the most important element to the patients since it gives the overall impression for the gamified part of the system and enables a suitable engagement. Patients must have a good experience thanks to the app so that they do not quit after a few consequent logins [7]. Personalization, for instance, using avatars, is a very powerful way to integrate fun. This will help to build a fair and solid engagement.

Moreover, the application will provide feedback for the doctors and developers with the data measured and by the daily questionnaires.

## 3 System Definition

### 3.1 Target Behaviours

One of the major problems of facing cancer is the treatment which causes a long set of side effects which can lead the patients to reduce their physical activity due to the depressive state and the fatigue acquired [6]. So, in order to beat these issues we want players to do more physical activity. Most of the activities guided by the system will imply some kind of slight movement, always within the patients' limits.

Patients will keep track of their personal progress thanks to the data collected and the badges and points earned. All the gathered information will be useful for the patient's self-improvement [7,8,9] and for medics to keep track of every patient's evolution. Some of the data measured, according to the clinical needs, will be the distance walked, the heart rate (HR) and the heart rate variation (HRV), and the oxygen saturation, all of this easily provided by a smartwatch with PPG embedded.

The design of the system will focus more on making those patients with good recovery perspective to stay in touch more regularly in a positive thinking environment.

### 3.2 Description of Players

**Patients.** The system is focused on patients sharing the same objective, beating cancer inside and outside the hospital, fighting cancer as a group.

Patients affected by cancer cover the whole range of possible ages. However, there is a higher amount of elder than young people in the balance. The application is intended to fit every kind of patient willing to beat cancer, but we are aware that younger people are going to find the gamified app easier to interact with since they have grown in a world surrounded by computers and videogames. So, the solution proposed is to make a whole community along this system where people who is used to game mechanics can include those who are not. We want those patients with good recovery perspectives to meet, to share the experience, to ensure they are all motivated and that they are fighting in the same boat.

On the other hand, cancer patients are affected by a huge social pressure which forbids weakness and demands them to strive to the maximum [6]. Nevertheless, patients need some depressive moments which are part of the natural defenses of the human body, hence the gamified application will not try to push them more than they actually are to avoid rejection.

**Medical Personnel.** Doctors, nurses and psychologists will be part of the community and receive detailed information of every patient's evolution.

### 3.3 Activity Loops

**Engagement.** An introductory session will explain the benefits of physical activity, social activities and positive thinking to beat cancer would be explained and how this gamified system may be useful to achieve that. In addition, patients will be informed that will be tracked individually without invasive instruments thanks to the smart-watch features. Then, an assistant will guide the patient through the different quests, missions and tasks he can do. There will be a wall where the badges attached to your achievements are collected. All this will allow patients to keep track of their personal progress just from a quick glance. There will be also surprise events and badges, unpredicted stimulus that will help patients to engage in the game-like dynamics [7].

**Progression Loops.** Progression is this intangible sense of advance you feel when looking backwards at any point in your life. The elements described before, the representation of achievements, are going to make this very possible and in an easy way.

Every quest, all very simple and rewarding tasks, will give the patient the points attached depending on the kind of activity. The points will be classified in five different categories: physical, social, mental, reflexive and emotional.

## 4 Conclusions

In this work we have proposed a gamified and biomonitoring system to boost cancer patients' recovery, taking into account the particular conditions of gamification applied to the elderly ones. The system has been designed according to the expert needs and recommendations from medics and psychologists from the hospital *Virgen de las Nieves* in Granada.

To develop this system we have chosen to integrate both biomonitoring and gamification in an Android-based design, making the most of the smartphone and smartwatch capabilities [10]. The smartwatch used must have PPG and motion tracking sensors embedded to enable the biomeasurements functions.

Finally, an iterative approach will be necessary to validate the whole system. Physical and psychological questionnaires will be reported by patients every day (medical feedback) with a weekly evaluation of the system's overall interface and performance (developer's feedback) so that all the technical issues detected could be solved.

**Acknowledgments.** This work was supported by the UGR Starting Grant 2015

## References

1. *World Cancer Report 2014*. Lyon, FRA: International Agency for Research on Cancer, 2014. <http://site.ebrary.com/lib/alltitles/docDetail.action?docID=11014806>.
2. A. Byrne, J. Ellershaw, C. Holcombe, and P. Salmon. «Patients' experience of cancer: evidence of the role of 'fighting' in collusive clinical communication». *Patient Education and Counseling*, Communication in Healthcare, 48, n.º 1 (September 2002): 15-21.
3. Z. Zhao, Etemad Ali, and A. Arya. «Gamification of Exercise and Fitness Using Wearable Activity Trackers». *Advances in Intelligent Systems and Computing* 392 (2016): 233-40.
4. K. Peters, F. Kayali, A. Reithofer, R. Wölfle, R. Mateus-Berr, J. Kuczwarra, Z. Lehner, et al. «Serious Game Scores as Health Condition Indicator for Cancer Patients», 210:892-96, 2015.
5. «Healthscape.ca mHealth: SickKids iPhone app helps kids with cancer fight pain». Accessed 3th February 2016. <http://www.healthscape.ca/Pages/mHealth-SickKidsPainSquad.aspx>.
6. P. Gutiérrez and M. Rodríguez. «Actuaciones Psicológicas». *Estrategias en el Cuidado y Seguimiento del Enfermo en Oncología Médica*. Granada: Grupo Ed. Universitario, 2003.
7. K. Werbach, D. Hunter. 'For the Win: How Game Thinking Can Revolutionize Your Business'. Wharton Digital Press, 2012.
8. O. Banos, C. Villalonga, R. Garcia, A. Saez, M. Damas, J.A. Holgado-Terriza, S. Lee, H. Pomares, and I. Rojas. 'Design, Implementation and Validation of a Novel Open Framework for Agile Development of Mobile Health Applications'. *BioMedical Engineering OnLine* 14, no. 2 (2015): 1-20.
9. F. de Vette, M. Tabak. «Engaging Elderly People in Telemedicine Through Gamification». *Journal of Medical Internet Research Serious Games*, n.º 2 (2015).
10. O. Banos, M. Damas, A. Guillen, L.J. Herrera, H. Pomares, I. Rojas, and C. Villalonga. 'Multi-Sensor Fusion Based on Asymmetric Decision Weighting for Robust Activity Recognition'. *Neural Processing Letters* 42, no. 1 (26 October 2014): 5-26.