Using Choreographies to support the gamification process on the development of an application to reduce electricity costs

Fernando Cassola[1,2], José Iria[1,3], Hugo Paredes[1,2], Leonel Morgado[1,4]
António Coelho[1,3], Filipe Soares[1]

[1] INESC TEC - INESC Technology and Science, Porto, Portugal, [2] UTAD – Universidade de Trás-os-Montes e Alto Douro, Vila Real, Portugal, [3] FEUP – Faculdade de Engenharia da Universidade do Porto, Porto, Portugal [4] Universidade Aberta, Lisboa, Portugal,
{fernando.c.marques, jpiria, antonio.n.coelho, filipe.j.soares}@inesctec.pt,
leonel.morgado@uab.pt, hparedes@utad.pt

Extended Abstract

Building automation systems contribute to reduce electricity costs by managing distributed energy resources in an efficient way. However, a large share of consumption cannot be optimized through automation alone, since it mainly depends on human interactions. Gamification can be used as one form of changing users' behaviours [1], but its implementation does require assumptions on the behaviour patterns that need to be identified, encouraged, or discouraged. To tackle this problem, we propose a framework that joins building automation solutions with gamification techniques to enable behavioural demand response.

Ultimately various authors converge to define gamification as "the use of game design elements in non-game contexts"[2]. So we use game elements and mechanics to engage and motivate end-users on an interactive platform [3]. To persuade this approach we will follow the Six Steps Gamification framework [4]. Additionally employ another gamification design framework, which places more emphasis on human motivation: Octalysis [5], proposed by Yu-kay Chou.

Several authors [6] tell us that the "knowledge acquired in an action-based and meaningful context promotes behavioural change"[7]. So we propose identifying users' behaviours that can be potentially relevant in a three phase process. In the first phase we will be using the building automation systems to monitor electric consumption of all actions produced by the building equipment (elevators, air conditioning, etc.) and inhabitants. Next we intend to extract users' behavioural patterns as choreographies related with energy consumption. After that, analysing the energy consumption of choreographies, we will promote the most effective ones employing gamification techniques (or even promote novel choreographies), with the goal of achieving electricity savings.

Employing platform-independent choreographies is a way to guarantee the interoperability and integration with other systems and approaches. First of all, because we have multiple input datasets from which to create the choreographies of the building devices and their occupants. Namely we are going to use the data given by the building

automation electricity meters and also use smartphone and desktop applications to collect indoor users' locations and behaviours. Platform independence will enable the future association/adaptation of choreographies to different inputs. The other reason is because we must be able to render them in various output systems. We need to employ a graphical interface, showing the collected behaviours associated energy consumption data, so human users can identify choreographies on that historical data registry. Choreographies will also be used on the gamified application in order to encourage users to adopt specific behaviours. So the platform independence enables choreographies to be treated as core data for this software solution, rather than a mere visual gimmick. For this purpose, we will follow the Ontology-based transformation approach for choreographies proposed by Silva et al. [8].

Concluding, this is an approach of using choreographies to support the gamification design process on the development of an application to reduce electricity costs. The primary obstacle to this field is to identify main behaviours and join them with the electricity meters. Another technical challenge is to draw alternative behaviours to reduce electricity costs. Rather the technical barriers we need to obtain a large spectrum of related behaviours and engage the building occupants to participate on this project.

Using the gamification techniques presented merged with the independent choreographies method we can expect to present a new way to engage people to reduce energy costs.

Acknowledgments. This work is financed by the FCT – Fundação para a Ciência e a Tecnologia (Portuguese Foundation for Science and Technology) within project SmartGP/0003/2015 under the framework of ERA-Net Smart Grids Plus.

References

[1] B. Burke, "Gamify: How Gamification Motivates People to Do Extraordinary Things," *J. Chem. Inf. Model.*, vol. 53, no. 9, pp. 1689–1699, 2013.

[2] S. Deterding, M. Sicart, L. Nacke, K. O'Hara, and D. Dixon, "Gamification. using game-design elements in non-gaming contexts," in *Proceedings of the 2011 annual conference on Human factors in computing systems - CHI EA '11*, 2011.

[3] K. Seaborn and D. I. Fels, "Gamification in theory and action: A survey," *Int. J. Hum. Comput. Stud.*, 2015.

[4] L. Mathiassen *et al.*, "For the Win: How Game Thinking Can Revolutionize Your Business," *J. Syst. Softw.*, vol. 38, no. 2, pp. 398–424, 2012.

[5] Y. Chou, "Octalysis – complete Gamification framework," *Website*, 2015. [Online]. Available: https://goo.gl/rjb1yq.

[6] E. C. Cordero, A. M. Todd, and D. Abellera, "Climate change education and the ecological footprint," *Bull. Am. Meteorol. Soc.*, 2008.

[7] J. J. Lee, P. Ceyhan, W. Jordan-Cooley, and W. Sung, "GREENIFY: A Real-World Action Game for Climate Change Education," *Simul. Gaming*, 2013.

[8] E. Silva, N. Silva, and L. Morgado, "Staging Choreographies for Team Training in Multiple Virtual Worlds Based on Ontologies and Alignments," in *Virtual, Augmented and Mixed Reality. Applications of Virtual and Augmented Reality SE - 10*, vol. 8526, R. Shumaker and S. Lackey, Eds. Springer International Publishing, 2014, pp. 105–115.