Journal of Ambient Intelligence and Smart Environments 1 (2014) 1–5
IOS Press

Playful Interactions and Serious Games

Albert Ali Salah [a,*], Ben A. M. Schouten [b], Stefan Göbel [c], and Bert Arnrich [a]
[a] *Department of Computer Engineering, Boğaziçi University, 34342, Istanbul, Turkey*
E-mail: {salah,bert.arnrich}@boun.edu.tr
[b] *Department of Industrial Design, Eindhoven University of Technology, 5600MB, Eindhoven, The Netherlands*
E-mail: bschouten@tue.nl
[c] *Multimedia Communications Lab, Technische Universität Darmstadt, 64283, Darmstadt, Germany*
E-mail: stefan.goebel@kom.tu-darmstadt.de

Abstract. Intelligent environments and smart applications require creating engaging interactions with their users, which on one side requires sensing and understanding human behavior, and on the other side carefully engineered application interfaces to keep these interactions sustained and useful over longer periods. Playful interactions and serious games incorporate elements of play for this purpose. As a fundamental human activity, play engages people at every age. This thematic issue explores how novel technologies can fuel fun and entertainment in ambient intelligence applications, and the societal implications and possibilities thereof.

Keywords: Playful interactions, serious games, exergames, wearable computing, interaction design, urban games

1. Introduction

The intelligence with which we endow our environments and the objects around us, has an increasing impact on our life styles and habits. Smart environments that can monitor their users, measuring interest and boredom, attention, affect, and different behaviors, make it possible to design systems that can employ these new information sources beneficially. Consequently, computer analysis of human behavior drives new kinds of interaction and applications, including new forms of play and new ways of having fun [29].

Play is an activity that is voluntary, intrinsically motivated, fun, incorporating free will/choices, offering escape, and fundamentally exciting [32]. The construction of something new by exploring the existing is inherent to play [10]. It is also instrumental for learning, self-regulation, rehearsal, and levels of involvement [5]. Mary Flanagan underlines the importance of what she calls Critical Play to resolve fundamental questions in life and/or society [12]. Play, in all its contemporary and digital forms, be it through games, social networks, applications on smartphones, interactive toys, or through interactive art, is an important activity in our modern life.

Playful interactions are interactions that incorporate elements of fun and play [4,9,16]. Serious games, on the other hand, are games that incorporate elements of serious applications, games that aim to teach, to exercise, to change behavior [14,19]. Both are closely related with the design of persuasive systems [13]. This thematic issue investigates several applications where ambient intelligence technology serves to create interactions that combine fun elements with serious purposes, which is the common property of both playful interactions and serious games.

2. Technological and human aspects

In many historical works about play, the definition of play is restricted to a specific ‘time and place’, separated from ordinary life (i.e. play takes place in a

*Corresponding author. E-mail: salah@boun.edu.tr. This version is the unedited author copy. Please cite this as Salah, A. A., Schouten, B. A., Göbel, S., Arnrich, B. (2014). Playful interactions and serious games. Journal of Ambient Intelligence and Smart Environments, 6(3), 259-262.

'magic circle') [15,6]. Digital ambient play, however, can be more integrated in a spatial, temporal and social sense [20] owing to new media, social networks, modern technology and (social) interaction. This enables the design of playful activities that are seamlessly integrated within our daily lives in such a way that the boundaries between other activities and play disappear or blur often referred to as ambient gameplay [30].

Ambient games are innovative game designs incorporating ambient intelligence characteristics, and they may lead to a fundamental new player experiences [1,11,28]. Several existing games and genres include some aspects of ambient intelligence, for example, pervasive and locative games [20]. These games blend the virtual and real world and are interacted with through multiple ubiquitous devices and as such offer context-aware and personalised features. Ambient intelligence environments may sense who is present, where they are, what they are doing, and when and why they are doing it. In line with this, ambient games offer context-aware and personalized features. They also may also allow players to play around move around freely, without being 'attached' to a computer screen or another device, by using information coming from sensors and mediated by different actuators such as intelligent toys. By their nature, they allow players to play throughout the day, as play and games may be incorporated in everyday objects and routines [31].

The technological advances that are relevant for playful interactions and serious games are in sensor and actuator technologies that monitor and respond to users' interest, attention, affective states, and physical behaviors, as well as algorithms that translate the sensory data into usable features [22]. This thematic issue contains papers that deal with algorithmic advances, as well as interaction design and user experience aspects of ambient games.

In current practice, games and playful interaction are often used as persuasive technologies, for example to stimulate physical and social activities. Persuasive technologies have been used for various purposes, ranging from digital health coaching and computer games that help reduce children's dentist anxiety, to technologies that influence the buying behavior of consumers on e-commerce websites [13]. Interactive interventions that stimulate young people to be more physically active are yet another application of persuasive technology.

These interactive interventions based on human-computer interaction define interactivity in terms of functionality, a solution-based view of the world based on usability [21,23]. However, gaming and playful interaction have added an extra dimension of creation, experience, social interaction and relatedness to interaction design, which goes beyond usability and functionality. To understand play in its digital form, the (changing) role of interaction is crucial. In modern digital practices, interaction is based on experiences and communication, which are not necessarily efficient or consistent. Subsequently, the human aspects need to complement the technological aspects.

Using ambient intelligence in games and play offer opportunities for more natural and improved interaction, because they are no longer confined to a television or computer screen, but can extend to the real world, using everyday objects as interaction devices [24,33]. In addition, ambient technology enables advanced awareness and personalization. This leads to more engaging experiences and increased flow, because the magic and suspension of disbelief are not broken by real world events. In this way, ambient gaming and play interaction moves from a more functional, goal-oriented role, to a playful experience that goes beyond usability, deriving meaning from its context. Designing ambient games and designing for ambient play requires a different role of the designer. Design processes move to co-creation, participatory design and other design methods where the user and the environment play an important and active role, reflecting the change to interaction as the creator, facilitator or mediator of experiences [25].

3. Contributions to the thematic issue

The thematic issue incorporates four papers [3,26, 18,17]. We briefly describe their highlights in this section.

Designing intelligent play environments to mediate experience requires design relevant knowledge, and the consideration of several aspects of playful behavior. In [3], Bekker et al. describe a toolkit called the *lenses of play* to facilitate the design of playful interactions and games for children. The design lenses do not illustrate a fixed set of technologies meant to empower a certain interaction, but facilitate in a generic way different phases of the design process.

Bekker et al. make a distinction between games (ludus) and free play (paidia) [3]. Children often engage in free play, which does not have fixed rules, and involves a lot of creativity. Free play is one of the major ways for children to explore social roles

and interactions [7], and subsequently, promoting free play through smart and tangible objects is a clear goal in playful interactions research. In [26], a wearable movement-to-sound accessory is designed to empower free play in children. A number of sensors are incorporated to this accessory to make it responsive to different stimuli, including a bend sensor. The participatory design experiments, as well as hardware and software considerations that go into the design of the accessory are detailed in [26]. The authors conclude that a successful smart interface for free play use would ideally incorporate opportunities of exploration and personal connection, high variability, responsivity to movement patterns, and a design that facilitates fostering novel social interactions and sharing.

In [18], a playful interaction system is proposed to teach children about history. One of the novelties introduced by this system is the use of autostereoscopic visualization. Tangible interfaces and social interaction during learning are known to be effective [27]. The study of [18] confirm this finding, and illustrate that novel interfaces and visualizations can be usefully adapted to learning scenarios designed in a principled, and theoretically grounded fashion. Following a number of design guidelines proposed by Villalta et al. [34], the authors establish that when designing for children, an accessible language and interactive guidance are particularly important. Following the suggestion of Bachour et al. [2], the authors try to balance the participation in the interaction, because in collaborative learning situations, subjects that participate less may end up having a poor learning experience.

Not all playful interaction designs are meant for children. Exergames are games that have physical exercising functions, and they can be used in physical rehabilitation, as well as skill learning. One of the earliest lessons of ambient intelligence research is that making everything easy for the inhabitant of an ambient setting can be detrimental to physical and cognitive well-being in the long run, if such simplification replaces physical and cognitive exercises that challenge, stimulate, and keep the person in shape [8]. Landry and Parés propose a purely vision-based measure to control the amount of physical activity involved in an exergame interaction [17]. This measure, called the *interaction tempo*, is shown to correlate highly with the heart rate, and the amount of physical activity. By controlling this parameter, the game difficulty can be selectively adjusted.

4. Conclusions

Playful interaction and games elicit explorative, social and enjoyable behavior. In such a way, playful interaction and serious gaming can be an effective means to persuade people to take part in educational activities or physical exercise. Game-based learning tools could help to improve the learning process by creating a motivating, dynamic and entertaining platform, as examples in this issue demonstrate.

The technological contributions of ambient intelligence for gaming, such as adaptivity and personalization, enable advanced design for different personalities and playing styles. Players can interact in different ways and assume different roles, depending on their personality: for example, a person with leadership qualities will play in the center of attention, while other users will explore on their own in a quiet moment. Differences in gender, age, character traits, group size will all influence playing styles. It is important to design for these different styles, so that both strong and timid interactions result in valuable responses for the users. In this sense, smart technology solutions are very promising for improving quality of experience.

Another important quality is situatedness; ambient playful interaction allows for interventions throughout daily life activities, in which the boundaries between activities, behaviors, and play will blur. In all these aspects of playful persuasion, we see the importance of making the activity intrinsically motivating: whether you want social play or physical play, the activity itself should be enjoyable, if you want to strongly motivate your users.

Finally, in terms of control and privacy, it is important to allow players to make informed choices about their engagement. Especially when the boundaries between play and non-play are blurred, as they may be in ambient games, the user may become part of a game unaware and unwillingly. Also, when play is no longer restricted to a pre-defined place in front of the television, or computer screen, data about players and players' actions may become publicly visible. This calls for a fine balance between control and engagement. Digital play and gaming as a process for user awareness and participation and creation could solve this problem.

The main challenge for human behavior analysis in this domain is to facilitate open-ended and free play in smart environments. Human computer interaction traditionally focuses on usability and functionality of 'cause and effect'. We see that this is changing now into exploration of dimensions in social interaction

and experience. That mainly defines the new challenge brought by playful interaction.

References

[1] E. Aarts and S. Marzano. *The New Everyday: Visions of Ambient Intelligence*, volume 116. 010 Publishing, Rotterdam, The Netherlands, 2003.

[2] K. Bachour, F. Kaplan, and P. Dillenbourg. An interactive table for supporting participation balance in face-to-face collaborative learning. *Learning Technologies, IEEE Transactions on*, 3(3):203–213, 2010.

[3] T. Bekker, L. de Valk, and B. Eggen. A toolkit for designing playful interactions: the four lenses of play. *Journal of Ambient Intelligence and Smart Environments*, 2014.

[4] T. Bekker, J. Sturm, and B. Eggen. Designing playful interactions for social interaction and physical play. *Personal and Ubiquitous Computing*, 14(5):385–396, 2010.

[5] A. Brock, S. Dodds, P. Jarvis, and Y. Olusoga. *Perspectives on play: learning for life*. Routledge, 2nd edition, 2014.

[6] R. Caillois. *Man, play and games*. New York: Free Press of Glencoe, 1961.

[7] J. Cassell and K. Ryokai. Making space for voice: Technologies to support children's fantasy and storytelling. *Personal and Ubiquitous Computing*, 5(3):169–190, 2001.

[8] D. Cook and S. Das. *Smart environments: Technology, protocols and applications*, volume 43. John Wiley & Sons, 2004.

[9] P. Coulton. Designing mobile and ubiquitous games and playful interactions. In *Playful User Interfaces*, pages 71–95. Springer, 2014.

[10] M. Deen and B. A. Schouten. Let's start playing games! how games can become more about playing and less about complying. In *Proc. 3rd Int. Conf. on Fun & Games*, 2010.

[11] M. Eyles and R. Eglin. Ambient games, revealing a route to a world where work is play? *International Journal of Computer Games Technology*, 2008:1–7, 2008.

[12] M. Flanagan. *Critical play: radical game design*. MIT press, 2009.

[13] B. J. Fogg. Persuasive technology: using computers to change what we think and do. *Ubiquity*, 2002(December):5, 2002.

[14] S. Göbel, S. Hardy, V. Wendel, F. Mehm, and R. Steinmetz. Serious games for health: personalized exergames. In *Proceedings of the international conference on Multimedia*, pages 1663–1666. ACM, 2010.

[15] J. Huizinga. *Homo ludens*, volume 3. Taylor & Francis, 1949.

[16] E. Kuts. Playful user interfaces: Literature review and model for analysis. In *Breaking New Ground: Innovation in Games, Play, Practice and Theory: Proceedings of the 2009 Digital Games Research Association Conference, London*, 2009.

[17] P. Landry and N. Parés. Controlling and modulating physical activity through interaction tempo in exergames: A quantitative empirical analysis. *Journal of Ambient Intelligence and Smart Environments*, 2014.

[18] J.-F. Martín-SanJose, M.-C. Juan, E. Torres, and M. J. Vicent. Playful interaction for learning collaboratively and individually. *Journal of Ambient Intelligence and Smart Environments*, 2014.

[19] D. R. Michael and S. L. Chen. *Serious games: Games that educate, train, and inform*. Muska & Lipman/Premier-Trade, 2005.

[20] M. Montola, J. Stenros, and A. Waern. *Pervasive games: theory and design*. CRC Press, 2009.

[21] J. Nielsen. *Usability engineering*. Elsevier, 1994.

[22] A. Nijholt, editor. *Playful User Interfaces: Interfaces that Invite Social and Physical Interaction*. Springer Verlag, 2014.

[23] A. Polaine. *Developing a language of interactivity through the theory of play*. PhD thesis, Faculty of Arts & Social Sciences, Sydney University of Technology, 2010.

[24] P. Rijnbout, L. De Valk, M. de Graaf, T. Bekker, B. A. Schouten, and B. Eggen. i-PE: A decentralized approach for designing adaptive and persuasive intelligent play environments. In *Constructing Ambient Intelligence*, pages 238–244. Springer, 2012.

[25] A. Rosales, E. Arroyo, and J. Blat. Evocative experiences in the design of objects to encourage free-play. In *Constructing Ambient Intelligence*, pages 229–232. Springer, 2012.

[26] A. Rosales, S. Sayago, J. Carrascala, and J. Blat. On the evocative power and play value of a wearable movement-to-sound interaction accessory in the free-play of schoolchildren. *Journal of Ambient Intelligence and Smart Environments*, 2014.

[27] B. Schneider, P. Jermann, G. Zufferey, and P. Dillenbourg. Benefits of a tangible interface for collaborative learning and interaction. *Learning Technologies, IEEE Transactions on*, 4(3):222–232, 2011.

[28] B. A. Schouten. The role of play. *Inaugural lecture presented at Eindhoven University of Technology*, 2011.

[29] B. A. Schouten, R. Tieben, A. van de Ven, and D. W. Schouten. Human behavior analysis in ambient gaming and playful interaction. In A. A. Salah and T. Gevers, editors, *Computer Analysis of Human Behavior*, pages 387–403. Springer, 2011.

[30] J. Sturm and B. A. Schouten. Ambient gaming and play: Opportunities and challenges. In *Constructing Ambient Intelligence*, pages 213–217. Springer, 2012.

[31] J. Sturm, R. Tieben, M. Deen, T. Bekker, and B. A. Schouten. Playfit: Designing playful activity interventions for teenagers. In *Proceedings of DIGRA*, pages 14–17, 2011.

[32] B. Sutton-Smith. *The ambiguity of play*. Harvard University Press, 1st edition, 2001.

[33] R.-D. Vatavu and I.-A. Zaiţi. An investigation of extrinsic-oriented ambient exploration for gaming applications. In *Constructing Ambient Intelligence*, pages 245–248. Springer, 2012.

[34] M. Villalta, I. Gajardo, M. Nussbaum, J. J. Andreu, A. Echeverría, and J. Plass. Design guidelines for classroom multiplayer presential games (CMPG). *Computers & Education*, 57(3):2039–2053, 2011.