A flock of sparrows in the city of Ghent: a multidisciplinary case study

Laurence Claeys[1], Tanguy Coenen[2], Thomas Laureyssens[3], Peter Mechant[2], Johan Criel[4]

[1] Vrije Universiteit Brussel
{Laurence.Claeys@vub.ac.be}
[2] iMinds
{Tanguy.Coenen@iminds.be}
{ Peter.Mechant@ugent.be}
[3] MAD-faculty (LUCA arts, KU Leuven)
{Thomas.Laureyssens@khlim.be}
[4] Alcatel-Lucent Bell Labs
{Johan.Criel@alcatel-lucent.com}

Abstract. This article elaborates on the deployment of multipurpose, aesthetic smart objects, called 'The Sparrows' in the city of Ghent (Belgium, Europe). The goals of the integration of the sparrows in the city were two-fold (1) augmenting the social engagement of citizens using a playful aesthetic smart artifact, and (2) exploring the ambient interaction zones with smart artifacts in a city context. In this article we present the case study carried out on the integration of the smart artifacts in the city and we describe the experiences of the involved citizens with the sparrows and the embedded ambient interactions.
Keywords: internet-of-things, ubiquitous computing, real-time data, ambient interactions, city, social engagement, ludic design

1 Introduction

Everyday life consists more and more of (often mobile) computational and communication resources assembled in heterogeneous ways making the ubiquitous presence of sensing devices a reality [1]. In the near future the presence of connected sensing devices will probably increase due to the rising number of ubiquitous available sensor networks in private and public spaces [2] and the rising number of smartphones or other mobile devices [3]. Also in the context of cities, we note an uptake in the amount of internet-connected objects. Still, these networked artifacts are only func-

tional and of interest to the people integrating the devices and capturing the data. If we want a lively city to arise where Internet connected things have a role to play, we should look for new ways of implementing Internet-of-Things (IoT) objects not only to make cities 'smart', but also to make citizens 'smart' and empowered.

One way of achieving this is to create and implement multifunctional smart city objects that are meaningful to different city stakeholders (e.g. citizens, city policymakers) without neglecting the business valorization potential. The discussed case 'a flock of sparrows in the city of Gent' is in this regard one of the first attempts to embed such smart objects in a city context pointing to the required affordances to make such objects actionable for different stakeholders and different goals.

2 The Internet of Things world is here to stay

Ubiquitous computing [4], pervasive computing [5], Internet of Things [6] or Ambient Intelligence [7] are different concepts that describe how intelligent computational devices get increasingly embedded in our every day life.

Although the disappearance of the infrastructure in the background, as initially predicted by Mark Weiser [4], has not yet become reality, the ubiquitous presence of sensing devices is taking foothold in society [1]. For example, smart phones having a diverse set of embedded sensors (e.g. location, distance, acceleration), in combination with the recent strong growth of adoption of smart phones [8] are already making the Internet-of-Things real and tangible.

In that sense the required scientific knowledge and the technical components and prototypes for the Internet-of-Things are almost in place. Various successful and unsuccessful applications in different domains are already on the market (e.g. health applications from Withing[1], social applications such as the Good Night Lamp[2], animal monitoring applications such as FitBark[3]). But the adoption and domestication of the Internet of Things (applications) by relevant (non-company) users and social groups only occurs partially. Among other things, privacy concerns and anxiety for getting stuck in habits defined by machines are important grounds for this lack of acceptance. However, these concerns will not stop the further uptake of Machine-to-machine (M2M) communications that is the basis for Internet-of-Things [9].

When referring to Social Construction of Technology (SCOT) Theory we could say interpretative flexibility [10] of the technology by different groups is still possible. There currently is no fixed meaning attached to Internet-of-Things objects or application. No monolithic mental model of the Internet-of-Thing world is established yet. This goes together with vagueness on the side of the technology developer and the user. Developers are still in search of the right features, interfaces, jargon and applications, while users are still adapting their opinions and practices to an Internet-of-Things world.

[1] http://www.withings.com
[2] http://goodnightlamp.com
[3] http://www.fitbark.com

The research described in this article tries to lift the veil of vagueness and transformation that is currently still part of the changing world of connected objects. We start this article with a description of the case of the sparrows and the context of their use during the four-week city intervention. Next, we discuss the defined human-sparrow interactions. Finally, we outline our empirical set-up and present our results and lessons learned based on the analysis of the collected data.

3 Case description

The flock of sparrows consists of eight multipurpose, aesthetic smart objects used as part of a city intervention and game called Zwerm[4]. The city intervention aimed at augmenting the social engagement of citizens within different neighborhoods in Ghent (a city in Belgium). Both engagement with each other and engagement with the city were the envisioned goals. In this context, we especially focused on 'neighborhood cohesion', a concept relevant for capturing locally available resources in the form of affective and instrumental support. Neighborhood cohesion has been referred to as the 'predominant property' worthy of investigation [11]. A neighborhood high in cohesion refers to a neighborhood where residents, on average, report feeling a strong sense of community, report engaging in acts of neighboring, and are highly attracted to live in and remain residents of the neighborhood. Zwerm used a number of gamification mechanisms to achieve this goal [12]. Around 250 citizens actively participated in the game during a period of four weeks (23 February 2013 – 22 March 2013). Different organizations[5] worked together on realizing Zwerm. In this article, we only discuss the sparrows.

3.1. The sparrows

A sparrow is a smart ambient artifact that embeds a set of dedicated, in-house developed sensors and actuators that are connected to the cloud (see Figure 1). During the trial the sparrows were attached to windowpanes of resident's houses using a suction-unit. Different people agreed on hosting a sparrow by providing access to their window or balcony to install the sparrow. The design of the smart object is inspired by Gaver's ludic design [13]. Ludic design aims to encourage reflection and exploration of meaning through designing for playful engagement and curiosity. Through the design of the 'ambiguous' sparrow object, citizens are stimulated to reflect about their environment and their interaction in urban space in a playful way. Central in ludic design is the creation of a playful, aesthetic interaction. The sparrows also consolidated different purposes into one object. Firstly, the sparrows are an interactive part of the socially engaging Zwerm city intervention. The sparrows react to whistling citi-

[4] Zwerm is the Dutch word for "flock of birds". A movie of the city intervention can be found at http://vimeo.com/65648085

[5] iMinds vzw (www.iminds.be), city of Gent (www.gent.be), MAD-faculty (www.mad-fac.be) and Alcatel-Lucent Bell Labs (http://www3.alcatel-lucent.com/wps/portal/belllabs)

zens by lighting up and randomly changing colors. Secondly, he sparrows unobtrusively measure different environmental parameters.

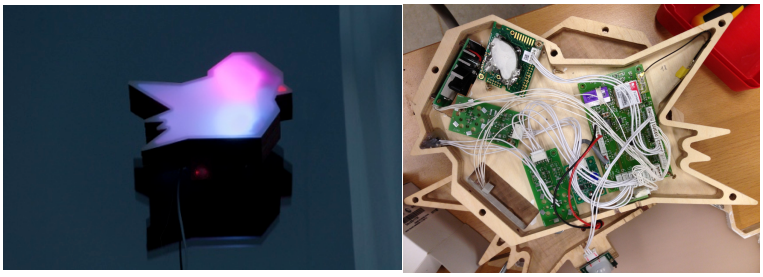

Fig. 1. Outside design of a sparrow (left), inside of a sparrow (right)

Each sparrow works autonomously, powered by a solar panel and communicates with the cloud using the mobile network. A sparrow contains a set of sensors (movement, light, CO_2 and noise sensors and 18 light-emitting diodes (leds) distributed over its surface. The information acquired by the sensors, such as whistling sounds, is send to the network, where it is consumed by different processes or stakeholders (see the 'distributed data' on Figure 2). This is done by the game engine as well as by the real-time analytics engine that transforms the raw sensor data into meaningful data before exposing it through the real-time data API[6] (other stakeholders could use this API to re-use the real-time data in other applications).

3.2. Human-sparrow interactions

As a guideline for the definition of the ambient interactions with the sparrows in the city, we look at the defined zones of interactions with ambient displays by Streitz, Rocker and Prante [14]. We divided the surrounding space of each sparrow in three different distance based zones (see figure 2). Each zone has its own semantics and interactions associated to it.

[6] API: Application Programming Interface

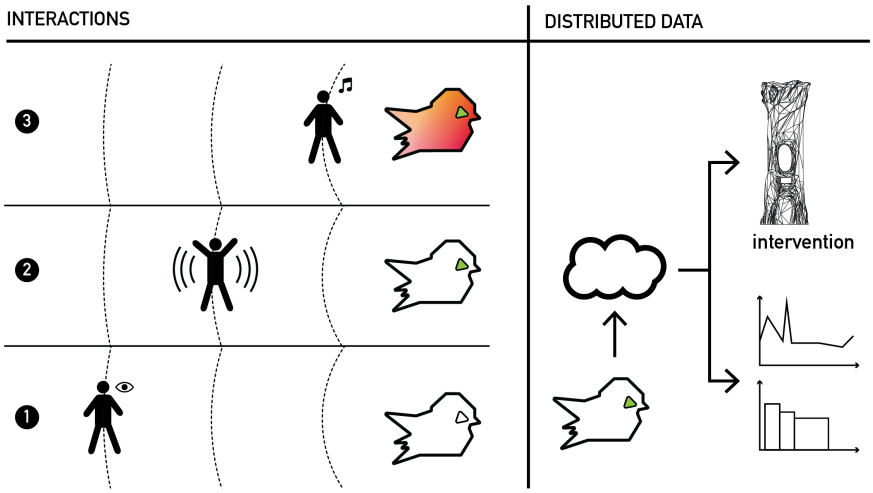

Fig. 2. The sparrow's ambient zones of interaction

(1) The ambient zone (the long distance interaction zone): a person who finds him/herself in a visible range of the sparrow but outside the range of the sparrow's sensors, experiences the sparrow in an ambient mode; the (leds inside the) sparrow acts independently of the presence of the person (number (1) on Figure 2);
(2) The notification zone (the moderate distance interaction zone): a person that comes closer to the sparrow (measured by a long range movement sensor) activates the eye of the bird (the eye becomes green) in order to attract the attention of the person passing by (number (2) on Figure 2);
(3) The interaction zone (the nearby distance interaction zone): when the person is in the vicinity of three meters of the sparrow, the person can whistle to it. The lights of the sparrow then start flickering, the beak of the sparrow lights up (which indicates that it starts sending data) and the color of the sparrow changes[7] (number (3) on Figure 2).

3.3. Real-time environmental data

The real-time data acquired by the sensors is made accessible online through REST[8] API's. The update frequency of the data is defined depending on its type. For example, the CO_2 and light levels are sent every five minutes, the noise level is only sent when a certain noise threshold exceeded and the whistling or person presence data is

[7] The sparrows were part of the Zwerm game because each time someone whistled to the sparrow the neighborhood where the bird resided got game points.
[8] REST=Representational State Transfer

only sent when the corresponding event is detected. Multiple third party applications use similar real-time data in their applications for different purposes, such as the comparison of air quality, monitoring efficiency of the solar panel or monitoring people gatherings.

4 Case study

4.1. Case study

Our research is part of an overall research project studying the impact of city interventions on stimulating citizen engagement. This overall research can be considered a case study because it can be defined as an empirical enquiry that investigates a contemporary phenomenon within its real life context where the boundaries between phenomenon and context are not clearly evident [15].

The flock of sparrows is only a small part of the study, but can take advantage of the gathered empirical data of the overall Zwerm research to gain insight in the possibilities of smart artifacts to create engaging, aesthetical playful interactions in the city and to try-out proximity-dependent ambient interactions. Because of the different methods and gathered data sources we are also able to triangulate our data. The goal of the described study is to explore, describe and in limited way explain certain aspects of the created and experienced socio-technical smart object interactions in the city context. The defined research questions are:

(1) How is a ludic designed smart object as the sparrow perceived by the involved citizens? Did it stimulate to reflect about the environment and the interaction in urban space?
(2) Did people perceive the zones of interactions as defined by Streitz when interacting with the sparrow?

4.2. Data collection

Different research methods are used, and different stakeholders are questioned. From the people that engaged (citizens) in Zwerm and interacted with the sparrows (1) participative observations (1 day) (2) observations (9 days) (3) informal interviews (40) (3) online questionnaires (55) and (4) log data was gathered.

4.3. Analysis

At the start of the city intervention 1441 people received an invitation (a Zwerm card) to participate. As we define participation to the intervention as using the received Zwerm card, we can state that 19,2 % of the invited population participated in

Zwerm. Evaluation results show that the general Zwerm city intervention was much appreciated by the citizens. 20% (n=55) of the citizens that were active participating in Zwerm answered the online questionnaire(s) and in that way participated in the research. More than 80% of them stated that Zwerm helped them to get to know the people in their neighborhood better, while more than 75% stated that Zwerm induced a sense of community and improved neighborhood cohesion. 48 from the 55 citizens involved in the research (87%) answered that they interacted with the sparrows, but the intensity of interaction with the sparrows varied greatly (Figure 3).

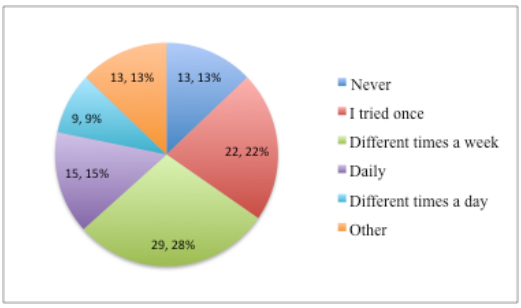

Fig. 3. The amount of times participants whistled at the sparrows

Creating a prototype with a multidisciplinary team, especially for combining design requirements with creating dedicated innovative sensortechnologies, is a real challenge. This is in part due to known obstacles in multidisciplinary teams such as vocabulary aligment, methodological burdens and power issues [16], but also some other challenges. One of the key challenges during the development of the sparrows as well as during the trial itself was the lack of a clear responsible for the integration process and the integrated solution (hardware, designed casing, software). This proved to be especially difficult since the integrator had to work with the constraint that only a prototype was created and not a final product. Also the group structure didn't facilitate the work. Normally an integrator is a person with the bird's eye view and the power to steer decisions in certain directions, but for this prototype a non-hierarchical decision-making structure was chosen.

From a technical angle working on multiple places in the city added the constraint of wireless solutions, for communicating with the cloud as well as for energy provisioning. The last one proved to be the most difficult one to tackle. Also the weather conditions and issues related to local conditions like the peculiar sounds made in the environment, movement and light conditions proved a challenge and where difficult to foresee beforehand. Each Sparrow needed a different fine-tuning. This had as implication that the sparrows had to go through different adaptions after their launch. This had clearly impact on the quality and intensiveness of the sparrow interactions (see also Figure 4).

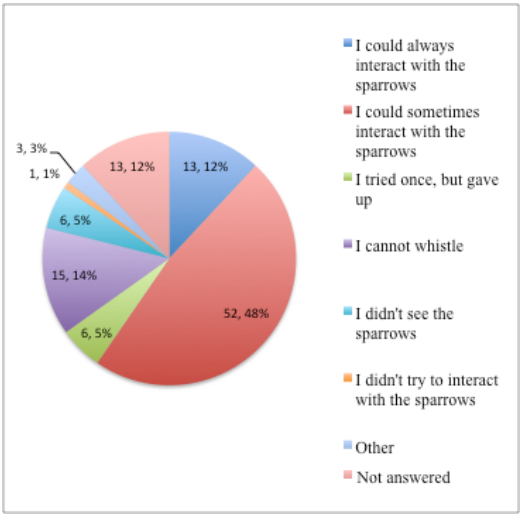

Fig. 4. The experience of the interaction with the sparrows

4.3.1. The ludic design of smart objects

Interviews, questionnaire and observations data show that the sparrows were perceived as playful and aesthetic objects, impacting the sense of neighborhood atmosphere for some inhabitants. Several players reported that they found the objects aesthetically pleasing. Especially the ever-changing random mix of colors proved a trigger for interaction. At numerous observations, citizens commented on the colors while whistling consecutively. One of the participants, a person hosting a sparrow, indicated in an interview that while he initially started whistling at the sparrow to score points for his team, at one point, exploring color variations became his main motivation. As a sparrow host, he had the opportunity to open the window on which the sparrow was attached, and could interact with it from a close distance. The majority of citizens of the neighborhood did not have access to sparrows at such a close distance, but this exemplifies how Zwerm players did not always interact with the sparrows for points alone. The questionnaire answers on the topic of motivations of interacting with the sparrows support this finding. Another underpinning of this finding is found in the way participants describe their experiences with the artifact. One participant portrays it as an absurdly playful experience "*how funny, doing crazy as kids on the street, jumping, weaving, whistling. to laugh. doing weird stuff*". Interacting with the sparrows also became a performance for spectators nearby, which in some cases provoked group interaction such as whistling in turns, or cheering when the bird lighted up. The sparrows also provoked a sense of ambiguity. One interviewee described the sparrows as generating curiosity about where it came from. Another

player described her impression of the sparrow upon seeing it for the first time with "*Such a nice design. I was wondering why it was hanging there.*" Using Gaver et al.'s classification of ambiguity [17] we can describe it as *ambiguity of information*. This type of ambiguity leaves it up to the viewer to interpret the object and its message, in this case, the reasons of its placement in the neighborhood and the message behind the whistling interaction and the changing of colors.

While the playfulness of the sparrows had a positive impact on the atmosphere in the neighborhood for some participants, it was not a complete success. Citizens that did not play the Zwerm game, and did not have the chance to see others interact with the sparrow, did not get enough cues on how to interact with the system.

Evaluating the prototype with the lens of ludic design [13], we can state that it was not effective. There were no observations of players who had interpreted the system in novel ways, or hints that the objects had provoked critical thoughts about the object or the neighborhood context it was embedded in. In hindsight, this is no surprise. The communication about the sparrows with the citizens wasn't done in a ludic design spirit, it was communicated that the goal of interacting with the sparrows was to score points. This explanation removes the ambiguity around the object and gives it a clear goal. As Gaver et al. note "*If people are to find their own meaning for activities, or to pursue them without worrying about their meaning, designs should avoid clear narratives of use. Instead they should be open-ended or ambiguous in terms of their cultural interpretation and the meanings—including personal and ethical ones—people ascribe to them.*" [13]. Maybe non-player citizens might have interacted with the sparrows with other motivations, but the questionnaire results only consisted of people engaging in the Zwerm game, which were all well aware of the Sparrow's functioning and the goal of scoring points. As a ludic system in Gaver's terms, we identify two points of necessary improvement: 1) communicate about the artifact in more ambiguous terms 2) design a more ambiguous link of the artifact with the rest of game than scoring points. Only then a ludic intervention could occur, this because the aim of scoring point is in contradiction with the openness of a ludic intervention.

4.3.2. The ambient zones of interaction

We did not explicitly advertise the required interactions to make the sparrows light up, neither did we supply explicit indications on their placement. Local social networks and social media proved to be efficient platforms for the spread of information on the placement and functioning of the sparrows, but were far from perfect. Therfore we now look into the experiences of the ambient zones of interactions. To answer the research question on the appropriateness of the zones of ambient interaction of Weiser, we analyze the different zones separately.

(a) The ambient zone:

The questionnaire data indicated that it was difficult to notice the sparrows while passing by without knowing in advance where they were located (see Figure 4). Also different comments of citizens state this difficulty, comments as "*they were smaller then I thought, I especially went looking for them, otherwise I wouldn't have seen them*" or "*I never saw one*", point clearly at a non-satisfactory creation of the ambient zone. Because only participants were questioned about their experiences, the above results only refer to them. So even while the participants of Zwerm could lookup the location of the sparrows online, they in general complained about their visibility. Non-participants have probably never seen them. We conclude that the visibility affordances should be made clearer for the ambient zones, especially if we want all types of users to be able to discover the system with no verbal explicit explanation.
Some possible improvements that could be made are: 1) increasing the size of the sparrows, 2) implementing repetitive light signals to attract people passing by or just 3) choose better locations for the sparrows.

(b) The notification zone:

The questionnaire data and observations taught us that the notification zone was not recognized as a separate zone. Persons perceived no difference between the notification and the interaction zone. While asking participants to describe the sparrow's interaction (in the questionnaire), participants always combined the illumination of the green eye (part of the notification zone) with the blinking of the whole sparrow while whistling (part of the interaction zone).

The reason for the elimination of the notification zone could be explained by a design decision we took to bypass a technical problem that was detected during the first days that the sparrows were installed. The problem consisted of false detections of whistling by environmental noise (e.g. by a wheezing tram passing near the sparrow or warning signals (beeps) by a truck driving backwards in front of a sparrow). This meant that not only the sparrows blinked more often but also that unjustified game points were awarded to the opponents in the game. We considered two possible solutions to resolve this problem. First option was to do nothing. This solution meant that we had to live with the false whistling detections. This wouldn't harm the ludic design (since it would have minor impact on the actual interactions and probably be perceived as part of the ambiguity related to the design choice) and not the assumed zones of interactions (it would most probably even increase the impact of the ambient zone since a blinking sparrow could attract more people's attention). From gaming perspective this remained, however, unfair. Second option was to tighten the original condition (=whistling) to avoid false positives. Instead of the initially two seconds of movement in front of the sparrow needed to illuminate the green eye (notification signal), we could change it to ten seconds and add the illuminated green eye as a necessary condition to detect a "valid whistling". This solved the false detection but this made the notification signal part of the interaction since it required long, deliberate movement in front of the sparrow.

We opted for the last solution since we would not decouple the birds from the whole game. It shows, however, the tension between the different purposes of the sparrows (game, zones of interactions, ludic design). This tension was recognized both during the design phase of the sparrows and during the actual intervention.

(c) The interaction zone:

The choice to change the interaction behavior (as described above) made it more difficult to trigger the interaction, which increased the drop out. One participant describes it as follows: *"It is apparently very difficult to adjust the sparrows so that they respond to human sound, and not on passing cars ... It can not be the intention to respond to any car or tram that passes, nor that you should be jumping, endlessly waving, whistling and calling, and still does not light up!"* Participants were not very happy with the made changes. Moreover the participants perceived this change as "changing the rules during the game". Some hosts even advertised the functioning of the birds with self-made posters to explain to citizens.

One additional observation was that the participants were looking for visual feedback to confirm that they got points after whistling to a sparrow. Many perceived the red blinking of the mouth of the sparrow as "getting points". We can conclude this out of the descriptions participants give on the working of the sparrows. One participant tells, *"How the sparrow works? move first nine seconds, then a green triangle is lightning up, whistle, then the sparrow lightens up in different colors, the red beak turns on and points are scored"*. This feedback was not designed for this purpose but perceived as this by the participants after discussing it with each other. This could be seen as a successful part of the ludic design, although not planned in beforehand

Although above analysis shows that the technical design and implementation of the zones of interactions failed for the vast majority, observations made clear that non-technical counterparts replaced the zones of the interactions in different ways during the intervention. For example, people sitting in the window and waving in front of the movement sensor of the sparrow. One participant tells, *"To activate the sparrow you should move untill the beak lights up, and then whistling untill the colors light up. If it does not work and the resident is at home, ask to open and close the window several times and then whistle and enjoy the colors"*. Another person tells *"Nice that someone whistles back, echoing behind the window. A friend of mine thought the sparrow really whistled back, but it was someone behind the open window, behind the curtain. Exciting invisible interaction with someone inside ... beautiful, especially at night when it is dark and you see lightening up the colors well"*. This human intervention didn't only made it more easy to interact with the sparrow, but there were also interventions that attracted the attention on the sparrow and in that way can be interpreted as a notification signal. Examples we observed were people playing the flute below the sparrow. This attracts people's attention (ambient zone), and because the flute player starts moving more and playing faster when a person comes to take a

closer look, the green eye illuminated what could be perceived as a notification signal (notification zone). When the person starts whistling him/herself this could be interpreted as interacting with the sparrow (interaction zone). The fact that the places with persons waving or playing the flute seemed to be the most popular places during the observations, could indicate that the importance of taking the zones of interactions into account while designing city related products.

5. Conclusions

The research on the four-week trial with the ambient sparrows provides interesting material on the perception and interaction of citizens with ambient artifacts in a city context. When looking back at our research questions we can conclude the following.

Our analysis shows that the Sparrow intervention functioned well within the overall Zwerm game system: citizens interacted playfully with the objects, and in some cases group interaction and social engagement emerged. The Sparrow was also widely used to score points for the teams. However for it to function well as an independent project the interaction affordances should be contained within the interface. Moreover, if the Sparrows are to function as a ludic design object, the relation and influence between the artifact and the other components of the ZWERM game should be made more ambiguous than scoring points.

The implementation of the zones of interaction with the sparrows was not very successful. Not only didn't the notification and interaction zone exist as separate zones, the lack of information on the interactions seemed not manageable for the citizens. The affordances should have been more explicit available to create the ambient zones of interaction in an intuitive way. Also the contradictory purposes of Ludic design and game mechanics and the chosen implementation in favor of the gaming aspect haven't benefited the ambient zones of interaction.

A lot of new ideas on future research on the design, implementation and interactions of ambient artifacts in city contexts that we hope we will be able to test during the next months.

Acknowledgment

The research leading to these results has received funding from the European Union's Seventh Framework Programmed FP7/2007-2013 under grant agreements n° 270971 (CIP-PSP SmartIP project). We thank the city of Ghent for their support and inputs.

References

1. Dourish, P., Bell, G.: Divining a Digital Future. Mess and Mythology in Ubiquitous Computing. Cambridge, Massachusetts, MIT (2011)

2. Szewczyk, R., Mainwaring, A. et al.: An analysis of a large scale habitat monitoring application. In: Proceedings of the 2nd international conference on Embedded networked sensor systems, pp. 214-226. Baltimore, MD, USA, ACM (2004).

3.http://epp.eurostat.ec.europa.eu/portal/page/portal/information_society/data/main_tables

4. Weiser, M.: The Computer for the 21the Century. Scientific American 265(3), pp. 94-104 (1991).

5. Ark, W. S., Selker, T.: A look at human interaction with pervasive computers. IBM Systems Journal 38(4), pp. 504-508 (1999)

6. Gershenfeld, N., R. Krikorian, et al.: The Internet of Things. Scientific American 291(4), pp. 76-81 (2004)

7. Aarts, E., Harwig, R. et al.: Ambient Intelligence. The Invisible Future: The Seamless Integration Of Technology Into Everyday Life. P. Denning, McGraw-Hill (2001)

8. Nielsen, The Mobile Consumer: A Global Snapshot. New York, USA
Diemen, The Netherlands, Nielsen Holding N.V. (2013).

9. Anzelmo, E., A. Bassi, et al.: Discussion Paper on Internet of Things, commissioned by the Institue for internet and society. Berlin (2011)

10. Bijker, W., T. P. Hughes, et al.: The social construction of technological systems: New directions in the sociology and history of technology. Cambridge, MA, MIT Press (1987)

11. Smith, R. A.: Measuring neighborhood cohesion: a review and some suggestions. Human Ecology 3(1), pp. 143-160 (1975)

12. Coenen, T., Mechant, P. et al. : ZWERM: stimulating urban neighborhood self-organization through gamification. Using ICT, Social Media and Mobile Technologies to Foster Self-Organisation in Urban and Neighbourhood Governance. Delft, The Netherlands (2013)

13. Gaver, W.W., Bowers, J., Boucher, A., et al.: The drift table: designing for ludic engagement. In: CHI EA "04: CHI "04 Extended Abstracts on Human Factors in Computing Systems (2004).

14. Streitz, N. A., Röcker, C. et al.: Situated Interaction with Ambient Information: Facilitating Awareness and Communication in Ubiquitous Work Environments. In: Tenth International Conference on Human-Computer Interaction (2003)

15. Yin, R.K. Case study research, Design and Method. Thousand Oaks, Sage Publications (2003)

16. Stewart, J., Claeys L. Problems and Opportunities of Interdisciplinary Work Involving Users in Speculative Research for Innovation of Novel ICT Applications. In: Pierson, J., Mante-Meijer, E., Loos, E. (eds.) New Media Technologies and User Empowerment. Peter Lang (2011)

17. Gaver, W.W., Beaver, J., and Benford, S. Ambiguity as a resource for design. In: CHI '03: Proceedings of the SIGCHI Conference on Human Factors in Computing Systems (2003).