Children and Smart Affective Objects

Rosella Gennari
Faculty of Computer Science
Free U. of Bozen-Bolzano
39100 Bolzano, Italy
gennari@inf.unibz.it

Alessandra Melonio
Faculty of Computer Science
Free U. of Bozen-Bolzano
39100 Bolzano, Italy
alessandra.melonio@unibz.it

Eftychia Roumelioti
Faculty of Computer Science
Free U. of Bozen-Bolzano
39100 Bolzano, Italy
eroumelioti@unibz.it

Abstract
Affective objects are physical objects related to the emotional sphere. When enhanced with technology, they are referred to as smart affective objects. Participatory design can be employed for engaging children in the creation of smart affective objects. Their participation can lead to innovative technologies and provide a valuable experience.

A participatory workshop in Italy involved primary school children and their teachers in the making of smart affective objects. The workshop used paper-based generative material and rapid prototyping toolkits. The paper concludes by reflecting on the results of the workshop and on challenges ahead for the making of smart affective objects at school.

Author Keywords
Child-computer interaction; Smart object; Participatory design; Physical computing; Emotion

ACM Classification Keywords
H.5.2. [Human-centered computing]: Haptic devices; Participatory design;

Introduction
Smart objects are physical objects augmented with computing and communication capabilities; they introduce a new type of human-object interaction [13]. Like in [9], in this

paper, smart objects are *affective* if they help people communicate or manage emotions.

Smart affective objects for children are usually designed by adults; children are at best involved as informants in the early design stage, or as users in the evaluation stage. At the same time, the participatory design and making communities alike advocate for a more active role of children in creating. That is especially important in the case of smart affective objects: firstly, children tend to have unconventional viewpoints about technology for them, which can inspire novel smart affective objects for them; secondly, enabling children to create their own smart affective objects augments their possibilities to express their inner selves, and creating opportunities for making children express their emotions is beneficial for their development in general.

This paper presents a workshop concerning smart affective objects created by children, assisted by designers and teachers. It starts by reviewing related work. It continues with the workshop description. It conludes by reflecting on the smart affective objects created by children, and on open challenges for bringing similar workshops into schools.

Related Work and Background

A preliminary literature review was conducted concerning smart affective objects or similar interactive products for children. The most relevant results for this paper are recappped as follows.

There has been considerable research in the area of wereables and emotions. Haptic interfaces were used in order to communicate emotions [10, 12], to improve family bonds [14], to facilitate emotional feedbacks such as human touch [6], or as a calm technology to support emotional communication [5].

There are also several research papers concerning the design of social robots for children, which allow children to communicate or manage their emotions, with a special focus on children with developmental disorders. For instance, that is the case of Roboparrot, an animal robot designed to comfort and emotionally interact with autistic children [11], and Puffy, which can interpret children's gestures and movements, facial expressions and help in scaffolding emotion management [2].

In that kind of research, children are usually involved as users in the evaluation of interactive solutions. In both participatory design and making communities, children are primarily involved as ideators or makers, rather than users; in participatory design communities, children tend to be involved in the ideation stage with paper based material, also in school classrooms, e.g., [3]; in the making communities children are involved in prototyping with child-friendly physical computing tools, usually in fabrication spaces, e.g., [1].

Recently, the authors of [4] organised workshops for ideating *and* prototyping smart objects with children from primary schools, in line with both participatory design and making traditions. The smart affective objects created in one of the workshops are for the first time described and reflected over in this paper.

Example Workshop

In 2017, co-authors of this paper organised workshops with different 8–11 years old children and their teachers. In the following, we focus on the latest workshop, which involved a primary school class of 22 children, 10–11 years old. It lasted c. two hours and it was held in the children facility of the authors' university, which is equipped with furniture and objects safe for children (e.g., toys like soft balls) and, like their school, has no typical fablab or even makerspace equipment. All children participated on a voluntary basis; their parents authorised their participation with a written consent form. The workshop also involved four designers, one per group, and two teachers. Teachers organised children in small groups, heterogeneous in terms of gender: Group 1 (G1) had 3 females and 2 males; Group 2 (G2) had 5 females and 2 males; Group 3 (G3) had 2 females and 3 males; Group 4 (G4) had 2 females and 3 males.

Teachers and designers agreed on the choice of creating objects related to emotions or social interactions: the choice was in line with teachers' class curriculum, and was likely to appeal to all children. The workshop was organised in three main stages: (1) ideation and conceptualisation; (2) prototyping and programming; (3) sharing. During all the stages except the last, designers acted as facilitators, with the help of teachers, and observers, by taking notes. During the sharing stage, children were video-recorded. After the workshop, teachers discussed with children of the workshop and then were interviewed by designers.

For the first stage, children used an adapted version of Tiles cards [7]; language was adapted to that of 8–11 years old children; new mission cards were introduced, related to social intractions, emotion communication, emotion management; novel object cards were introduced, by considering common objects for children, which can be easily customised or used as-is, e.g., paper, soft balls, and made available in the children university facility; input and output cards were selected or novel ones were introduced that could be mapped, one-to-one, to available programmable sensors and actuators for the prototyping stage. Groups were given paper-based conceptualisation frameworks; they placed their cards in the frameworks, in order to establish simple if-then rules for the interaction with objects so as to achieve the chosen mission (if sensors detect INPUT then actuators trigger OUTPUT). See Figure 1. In the prototyping and programming stage, children prototyped and programmed their objects with SAM labs [8], using their conceptualisation frameworks. During the sharing stage, groups presented their frameworks and objects.

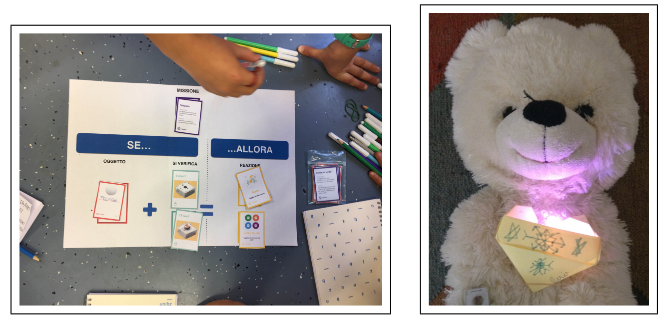

Figure 1: The conceptualsiation framework with cards and smart affective teddy bear

The objects of the workshop were as follows.

G1 chose a necklace as object card, and the emotion communication card ("how do I feel?") as mission. They used a light sensor as input card. They also used two output cards: for RGB LED and emoji. The intearction is as follows: if a child feels radiant, the necklace perceives it and the child does not cover the necklace; then the RGB LED lights up with red or orange. Else, if the child feels bad, the necklace perceives it and the the child covers the necklace; then the RGB LED lights up with dark colours.

G2 chose a soft ball as object card, and negative emotion management card as mission. G2 realised a free-from-stress ball. They used the input card of the pressure sensor. They chose two output cards: for vibration and RGB

LED actuators. When pressed, the ball vibrates and lights up, cycling through different colours according to pressure.

G3 chose a soft ball as object card, and emotion communication and negative emotion management cards as missions. G3 realised another free-from-stress ball. They used two input cards: for a pressure sensor and a button. They chose two output cards: for emoji and an RGB LED actuator. When a child is angry and presses the ball, this is expected to text an emoji to a friend asking for help (e.g., via Twitter). When the child is relaxed and pushes the button of the ball, this lights up with relaxing colours.

G4 chose a puppet as object card, for emotion communication and negative emotion management: they realised an emotional teddy bear. See Figure 1. The teddy bear should understand when children wish to relax. They used two input cards, for proximity and light sensors, respectively connected to two output cards, namely, for sound and an RGB LED actuator. The bear is expected to sing the group's favourite song when they get near the bear, and light up, cycling trough different rainbow colours, when it is getting dark—because children wanted to feel welcomed and relax when the night comes.

Reflections and Future Work

This paper reports on the creation of affective objects with primary school children, assisted by designers and teachers, in a dedicated workshop. Reflections follow concerning the workshop objects and the involvmenent of participants.

All children chose mission-cards related to emotions, even though the workshop allowed children to choose others. That could be explained by the age of children; when they are 10–11 years old, children's concerns for their inner emotional sphere grows. The chosen prototyping toolkit was limiting at points for emotions: it did not offer a wide range of sensors for enabling children to create their smart affective objects. However, all children, assisted by facilitators, managed to express and share their ideas by showing the intended interactions with their prototypes. Interestingly, all children wanted and added RGB LEDs in their objects. During the sharing stages, children were mostly engaged by sound: when they were asked which objects they preferred, all voted for the teddy bear, which had sound associated to it. They all laughed joyfully when it was presented; firstly it sang a melody, then children wanted it to bray, scream and produce other sound effects. The workshop suffers from typical limitations of participatory work (results are context-related, and difficult to generalise). However, designers gained insights concerning children's expectations of smart affective objects, e.g., concerning the range of emotions they consider, besides sensors and actuators.

Another limitation is that teachers were involved marginally in the workshop, mainly for assisting designers. However, the workshop whetted their appetite for bringing such initiatives at school, and one of them already asked the designers for an education program concerning making at school—an initiative which is ongoing, following the design of similar ones in other countries [1]. In line with previous design experiences with schools, e.g., [3], it also seems that starting with paper-based material (Tiles-like cards and the conceptualisation framework) has made teachers feel on safe ground. Based on the results of the experience reported in this paper, workshops are being organised with teachers as participant designers in their learning contexts, in which designers are acting as teachers' facilitators.

REFERENCES

1. P. Blikstein. 2018. Maker Movement in Education: History and Prospects. In *Handbook of Technology Education*, Marc J. de Vries (Ed.). Springer.

2. Mirko Gelsomini, Giulia Leonardi, Marzia Degiorgi, Franca Garzotto, Simone Penati, Jacopo Silvestri, Noëlie Ramuzat, and Francesco Clasadonte. 2017. Puffy - an Inflatable Mobile Interactive Companion for Children with Neurodevelopmental Disorders. In *Proceedings of the 2017 CHI Conference Extended Abstracts on Human Factors in Computing Systems (CHI EA '17)*. ACM, New York, NY, USA, 2599–2606. DOI:http://dx.doi.org/10.1145/3027063.3053245

3. R. Gennari, A. Melonio, D. Raccanello, M. Brondino, G. Dodero, M. Pasini, and S. Torello. 2017a. Children's emotions and quality of products in participatory game design. *International Journal of Human-Computer Studies* 101 (2017), 45 – 61. DOI: http://dx.doi.org/https://doi.org/10.1016/j.ijhcs.2017.01.006

4. Rosella Gennari, Alessandra Melonio, Mehdi Rizvi, and Andrea Bonani. 2017b. Design of IoT Tangibles for Primary Schools: A Case Study. In *Proceedings of the 12th Biannual Conference on Italian SIGCHI Chapter (CHItaly '17)*. ACM, New York, NY, USA, Article 26, 26:1–26:6 pages. DOI: http://dx.doi.org/10.1145/3125571.3125591

5. Yoonjung Hong, Jaesung Jo, Yoonhee Kim, and Tek-Jin Nam. 2010. 'STEPS': Walking on the Music, Moving with Light Breathing. In *CHI '10 Extended Abstracts on Human Factors in Computing Systems (CHI EA '10)*. ACM, New York, NY, USA, 4799–4804. DOI: http://dx.doi.org/10.1145/1753846.1754234

6. S K Alamgir Hossain, Abu Saleh Md Mahfujur Rahman, and Abdulmotaleb El Saddik. 2010. Interpersonal haptic communication in second life. In *2010 IEEE International Symposium on Haptic Audio Visual Environments and Games*. 1–4. DOI: http://dx.doi.org/10.1109/HAVE.2010.5623973

7. S. Mora, F. Gianni, and M. Divitini. 2017. Tiles: A Card-based Ideation Toolkit for the Internet of Things. In *Proceedings of Designing Interactive Systems (DIS2017)*. ACM, New York, NY, USA, 587–598. DOI: http://dx.doi.org/10.1145/3064663.3064699

8. Sam Labs. 2016. SAM Labs Education. (2016). https://www.samlabs.com/education.

9. Jocelyn Scheirer and Rosalind W. Picard. 1999. *Affective objects*. Technical Report. MIT Media Laboratory Perceptual Computing Section.

10. Jinsil Hwaryoung Seo, Annie Sungkajun, and Meghan Cook. 2017. InTouch Wearables: Exploring Ambient Remote Touch in Child-Parent Relationships. In *Proceedings of the Eleventh International Conference on Tangible, Embedded, and Embodied Interaction (TEI '17)*. ACM, New York, NY, USA, 671–676. DOI: http://dx.doi.org/10.1145/3024969.3025057

11. P Soleiman, S Salehi, M Mahmoudi, M Ghavami, H Moradi, and H Pouretemad. 2014. RoboParrot: A robotic platform for human robot interaction, case of autistic children. In *2014 Second RSI/ISM International Conference on Robotics and Mechatronics (ICRoM)*. 711–716. DOI: http://dx.doi.org/10.1109/ICRoM.2014.6990987

12. James K. S. Teh, Zhenling Tsai, Jeffrey T. K. V. Koh, and Adrian D. Cheok. 2012. Mobile implementation and user evaluation of the Huggy Pajama system. In *2012 IEEE Haptics Symposium (HAPTICS)*. 471–478. DOI: http://dx.doi.org/10.1109/HAPTIC.2012.6183833

13. Secil Ugur Yavuz, Roberta Bonetti, and Nitzan Cohen. 2017. Designing The "Next" Smart Objects Together With Children. *The Design Journal* 20, sup1 (2017), S3789–S3800. DOI: http://dx.doi.org/10.1080/14606925.2017.1352882

14. GwangRae Yeom, Garam Lee, Dayoung Jeong, Jeonghoon Rhee, and Jundong Cho. 2017. Fam-On: Family Shared Time Tracker to Improve Their Emotional Bond. In *Proceedings of the 19th International Conference on Human-Computer Interaction with Mobile Devices and Services (MobileHCI '17)*. ACM, New York, NY, USA, Article 106, 106:1–106:8 pages. DOI: http://dx.doi.org/10.1145/3098279.3122149