
Smart Toys, Smart Tangibles, Robots and other Smart Things for Children

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Abstract

Embedding electronics and enabling digital responses to everyday objects is already a widespread reality. The term smart toys, tangibles and robots cover a range of play products that can present different levels of network, processing and reasoning capabilities. Such interfaces have also become capable of collecting and processing data in real-time. While quality aspects and intelligent features are more relevant than ever, many relying on data-driven methods and artificial intelligence (AI), this also raises important privacy issues and concerns. Additionally, the design of meaningful play and learning experiences that go beyond data collection remains a challenging task. This workshop aims to explore challenges and related opportunities to feed interaction design of smart toys, tangibles, robots and other smart things for children that may shape the lines for future work in the field. It aims at bringing together researchers, non-academicians and, practitioners from relevant disciplines to discuss potentials and limitations of using various smart technologies for children, to define required methodologies, and to envision alternative future scenarios that fully unleash the potential that the new generation of AI-powered smart tangibles and related devices may bring.

Author Keywords

Smart Toys; IoT; Tangible User Interfaces; Digital manipulatives; Tangible Robots, User-centred Design, Children.

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Background

Embedding electronics and enabling digital responses to everyday objects is already a widespread reality. Toys enhanced with animated behavior that exhibit, to some extent, autonomous and believable behavior in response to environmental and activity stimuli is something that has progressively been investigated [1]. The term smart toys, tangibles and robots cover a range of play products that can present different levels of network, processing and reasoning capabilities.

Since seminal contributions to the design of computational toys, such as the curlybot [7], researchers have continued exploring and trying out prototypes and settings that may involve toys [10], specially-designed tangible sets that foster the development of narrative and social skills [15] and robots [2, 12, 6]) with different degrees of smart responses and interaction capabilities. Thus, smart toys appear in various shapes, and ranging degrees of anthropomorphism, such as humanoid, plush toys, dolls, blocks, tangible robots, companion robots or wearable gadgets [5].

Some authors have attempted to define the general properties of smart toys, considering that: they are 1) pervasive - the smart toy may follow the child through everyday activities, 2) social - social aspects and multiplayer options are becoming an important aspect of interactive Internet of Toys (IoT) in a one-to-one, one-to-many and many-to-many relations [16], 3) interactive - equipped with sensors and response to input, and 4) connected - contemporary smart toys may connect and communicate with other toys, services and online platforms through Wi-Fi and/or Bluetooth [9, 8]. Together with a computing and communication capability, their connectivity is so well integrated with the plaything that the technology “disappears” [13].

The access to marketed smart toys is also increasing their

popularity. The fact that some even come with a software development kit rather than being completely closed devices opens new opportunities in the design of interactive settings. Actually, this allows researchers to go further beyond the toy itself and the associated STEM marketed app by involving other devices and peripherals which may also be connected remotely as part of the interactions. For example, by combining tangibles, robots and tablets to be part of the same interactive setting for children to develop storytelling skills [17].

The integration of e.g. smart speakers [11] or other appliances seems also relevant and could potentially contribute to this view as well as to the landscape of smart devices that could enrich children’s interactions.

Similarly, robots and tangibles can also be used as tools to provide collaborative learning activities, as well as enhanced sensory information, as Asselborn and Guneyasu et al. demonstrated in a previous study that used the palm-sized, haptic-enabled Cellulo robots to help preschoolers and children with visio-motor coordination problems learn the grapheme and the ductus of letters [2, 12]. Mobeybou uses small wooden blocks that can be connected to each other to trigger digital content and communicate with the computer via Bluetooth. The tool offers children a playful environment for creative storytelling within a multicultural context [15].

The work in [3] has presented Toy-user-interfaces (ToyUI), which are computing devices or peripherals that leverage interactivity and connectivity with other devices to promote physical and social play. The research focuses on ToyUI, which involves different computing technologies to obtain real-time data used then to regulate play rules (e.g tracking of both objects and users), and to provide contextual feedback to the players.

Design Practices

Smart toys have become capable of collecting and processing data in real-time, however the design of meaningful play experiences that go beyond non-personal data collection remains a challenging task for most toy makers [3]. This gap needs best design practices and providing adequate tools for the smart toy design. Research in [4] has elicited five requirements to build generic rapid prototyping tools (RPT) for smart toys, which are: 1) support adaptability by design, 2) allow distributed data collection, 3) offer multi-modal user feedback, 4) support different play features, 5) limit personal data collection [4].

Within this context, there are several issues that clearly remain open. Firstly, the shape and the interaction modality of smart toys must not be restricted beforehand, and as research and current trends suggest, it is fundamental to think in terms of settings which may involve an ecosystem of smart interconnected devices. Secondly, the scope of interactions varies depending on where the smart setting should work and its goal, i.e., at home for social purposes, at school for individual or collaborative learning either with special need communities or typically developed children, at public space for playful interaction, or intercultural connectivity, etc. Thirdly, quality aspects and intelligent features are more relevant than ever, many relying on data-driven methods and artificial intelligence which lead to important privacy issues and concerns.

For the above, designing such interactive settings needs to be done in a currently synergistic fashion so that the system's functional/non-functional requirements are met while being highly transparent and not harming trust in the system because of data moving among interconnected devices. This requires dealing with design from multiple perspectives and backgrounds, and to discuss how co-design

[14] should be applied for the specific case of designing settings that use smart toys, tangibles, robots and other smart things. In particular, this workshop seeks to fertilize interdisciplinary discussion among researchers and practitioners in order to define required methodologies, and envision new future scenarios that fully unleash the potential that the new generation of AI-powered smart tangibles and related devices may bring.

It is crucial to target the design of activities for children from a multi-perspective and interdisciplinary point of view. This workshop will provide a forum for researchers, practitioners and non-academicians from a variety of backgrounds to discuss potentials and limitations of using various smart technologies (tangible, wearable, toy, robot etc.) for children.

Objectives and Expected Outcomes

This workshop aims to openly discuss challenges and related opportunities to feed interaction design of smart toys, tangibles, robots and other smart things for children that may shape the lines for future work in the field. Following themes will be addressed:

- 1) Design methods and methodologies: Which important principles must be considered to design such smart technology settings for the future?
- 2) AI-powered devices and data-driven interactions: How shall data privacy and ethics issues be handled? Which special considerations about the General Data Protection Regulation (GDPR) must be taken with children? How to ensure an adult/tutor is involved in the acceptance of conditions and they are clearly explained to children? Should we need a specific manifesto for toy designers regarding user data processing besides existing regulations?

- 3) Shaping and scoping smart settings with smart toys, tangibles, robots and other devices: Which contexts are worth exploring and other target users considerations? What different future technological settings can be interesting to explore? Which scenarios can we (participants) anticipate or could be interesting to explore in the future? In which use-cases can the smart tangibles be used to promote children's learning? In which scenarios can smart tangibles be useful for different user groups such as children having attention problems, children having visio-motor coordination issues, learning difficulties, etc.?

Expected outcomes from this workshop are to have a rich and shared overview on the theme, relying on the participants' diverse perspectives, and to establish a network of both researchers and practitioners to initiate collaborative initiatives to start up multiple research projects and strands based on the ideas and cluster work to be carried out during the workshop (see the workshop plan).

Workshop Plan

We aim to gather about 10-15 participants working in related areas, such as child-computer interaction, tangible and embodied interaction, human-robot interaction as well as teachers, therapists and experts on a variety of intelligent interactive systems and IoTs who are interested in designing specifically for children. We also welcome non-academics and practitioners that work/are interested in the topics targeted by the workshop.

A website specifically created for the workshop will provide regularly updated relevant information. The submissions to the workshop will be done via email, following the instructions given in the website.

Pre-Workshop Plans

Prior to the workshop, we will disseminate the call for participants (CFP) in our networks and specialized communities. The CFP will invite potential attendants to submit an extended abstract (2-4 pages) explaining their interest, experience, studies and viewpoints on the topics targeted by the workshop. Submissions should follow the ACM Sigchi Extended abstract format. We welcome three different types of contributions: 1) Position papers in relation to any aspect relevant to the workshop; 2) Live-demo or video, accompanied by a short description and potential benefits as an input to the workshop; 3) Expression of interest to participate by students, non-academics and practitioners, describing their background and a motivation of what they would like to do/achieve in relation to the topics of the workshop. The contributions will be subject to a juried process to assess their relevance for the workshop, ensuring diversity as well. Accepted contributions will be distributed internally among the participants to facilitate workshop preparation and networking, on the premise of not redistributing the materials.

To advertise the workshop, we will release the CFP reaching the main related communities (CHI, IDC, TEI, CC, HRI) via twitter, mailing lists and groups (e.g. IDC, SIG, CHI announcements, TANGIBLE-INTERACTION, HRI, IUI), as well as related Facebook groups, such as CHI, Child-Computer Interaction Research, Educational Interfaces, Software, and Technology EIST, Seymour Papert Tribute. The CFP will also be posted into wikicfp, which is a more general tool for other researchers to find calls that match their interests. Furthermore, we will promote the workshop through word-of-mouth advertising within our own networks.

Workshop Structure

The workshop will provide participants the opportunity to engage in different activities. It will start with a speed net-

working activity as an icebreaker that will foster connections. Afterwards, the participants will share their experiences, studies and contributions through video, demos and presentations. This input will feed the focus group session, in which identification and discussion of main existing approaches will be carried out.

In the second half of the workshop, participants will work in small groups or clusters. Each group will be requested to define scenarios and ideate/design interactions. Participants will be requested to share pictures of existing resources that could be used as part of interactive settings with smart toys. For example, the organizers will display some technologies such as Cozmo/Vector robots, Mobeybou, Surfacebot and Cellulo tangible robots. The purpose is that these systems inspire imagined designed interactive settings/scenarios for different use-cases and targeted groups of children. Following the ideation activity, the concepts will be presented to the whole audience, encouraging discussion on potential alternative designs as a way to improve rationale and expand visions for smart toys.

Finally, time will be allocated to foster open discussions for plans to establish collaborations, create synergies and discuss possibilities for joint publications.

With the conference turning fully virtual due to COVID19 pandemic, a combination of digital tools covering both synchronous and asynchronous communication will be used to support the implementation of the following activities:

- Speed-Networking Activity
- Participant's Input - Show & Tell
- Discussion: Current approaches methods, Data ethics issues, target users and open challenges in design

- Cluster work: Ideation session for alternative designs, alternative use-case scenarios and alternative target groups
- Synopsis and general discussion on limitations and potentials of proposed alternative designs during cluster work
- Plans for collaborations, synergies, reports and publications

Post-Workshop

We will facilitate the creation of a mailing list for the workshop participants who would like to join the post-workshop discussion and keep in touch to work on the theme. This will allow us to share a summary of the workshop outcomes, and keep them updated regarding opportunities for publishing their ongoing work. Furthermore, we will ask the participants to fill in a short survey in order to gather feedback on the implementation of the workshop and elicit additional possible ways of collaboration between the participants, which we will consider in future collaborative actions. We plan to publish a workshop report and edit a special issue at the International Journal of Child Computer Interaction, inviting participants to submit an article.

Organizers

Alejandro Catala is a researcher funded with a Juan de la Cierva's research grant. Previously, he held a Marie Skłodowska-Curie grant. His background is in Human-Computer Interaction, bringing intelligent user interfaces in several application domains and technologies. His main interests include learning and collaborative systems with a focus on creativity development and tangible interaction as well as conversational interfaces to support natural communications.

Cristina Sylla has a strong expertise in interaction design for children, being part of the editorial board of the International Journal of Child Computer Interaction, IJCCI. She has run several workshops on the topic of interaction design for children and tangible interfaces at ACM CHI, ACM IDC, as well as Children's creativity labs at ACE. Her work has received several awards such as the World Technology Award (WTA) 2013, for entertainment. Presently she leads the Mobeybou research project (mobeybou.com) at the University of Minho, focusing on the development of digital manipulatives for multicultural storytelling.

Arzu Guneyusu Ozgur is a doctoral researcher in Computer Human Interaction in Learning and Instruction laboratory at EPFL, Switzerland. She holds an M.Sc. degree in Computer Engineering from Bogazici University where she worked on socially assistive robots for exercise coaching for children. She is currently working on tangible robot-mediated gamified therapy for stroke patients and children with developmental coordination disorder. Her current research focuses on co-designing robot-assisted single and multi-user activities for physical and cognitive training, as well as for learning handwriting.

Pirita Ihämäki holds a Doctor of Philosophy, Master of Sciences (Economics) and Vocational Educators degrees and currently works as a Project Manager at Prizztech as head of Gamecoast. She has published several studies for Internet of Toys and smart toys in kindergarten context. She has currently received best paper awards the topics of Ready, Steady, Move! Coding Toys, Preschoolers, and Mobile Playful Learning and Gamified Coding: Toy Robots and Playful Learning in Early Education. Her main research interests include Internet of Toys within toy-based learning environments with a focus on collaborative learning and smart toy-children interaction.

Katriina Heljakka holds a postdoctoral position at University of Turku (digital culture studies). Her background is in toy research with a particular interest in adult toy play. Heljakka currently studies smart toys, playful environments, tools and techniques in the workspace and the visual, material, digital and social cultures of play at Pori Laboratory of Play, which she leads as research manager. Her main interests include the emerging toyification of culture, toy design, playful spaces and the hybrid and transgenerational dimensions of ludic practices.

Call for Participation

Embedding electronics and enabling digital responses to everyday objects is already a widespread reality. The term smart toys, tangibles and robots cover a range of play products that can present different levels of network, processing and reasoning capabilities. Such interfaces have also become capable of collecting and processing data in real-time. While quality aspects and intelligent features are more relevant than ever, many relying on data-driven methods and artificial intelligence (AI), this also raises important privacy issues and concerns. Additionally, the design of meaningful play and learning experiences that go beyond data collection remains a challenging task. This workshop aims to explore challenges and related opportunities to feed interaction design of smart toys, tangibles, robots and other smart things for children that may shape the lines for future work in the field.

We invite researchers, non-academics and practitioners that work/are interested in the topics targeted by the workshop to join us at IDC 2020 to critically reflect on these aspects.

Attendants are requested to submit an extended abstract (2-4 pages) following the ACM Sigchi Extended abstract

format. We welcome three different types of contributions: 1) position papers in relation to any aspect relevant to the workshop; 2) Live-demo or video, accompanied by a short description and potential benefits as an input to the workshop; 3) Expression of interest to participate by students, non-academics and practitioners, describing their background and a motivation of what they would like to do/achieve in relation to the topics of the workshop.

Submissions to the workshop will be done via email following the instructions given in the workshop website¹. The contributions will be subject to a juried process to assure their relevance for the workshop, ensuring diversity as well. At least one author of each accepted position paper must attend the workshop and all participants must register for both the workshop and the main conference.

Important Dates: Submission of contributions, 10 May; Notification of acceptance: 15 May; Workshop: 18 June

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¹<https://sites.google.com/view/smarttoysidc2020>

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