Internet of Tangibles: Exploring the Interaction-Attention Continuum

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Abstract
There is an increasing interest in the HCI research community to design richer user interactions with the Internet of Things (IoT). This studio will allow exploring the design of tangible interaction with the IoT, what we call Internet of Tangibles. In particular, we aim at investigating the full interaction-attention continuum, with the purpose of designing IoT tangible interfaces that can switch between peripheral interactions that do not disrupt everyday routines, and focused interactions that support user's reflections. This investigation will be conducted through hands-on activities where participants will prototype tangible IoT objects, starting by a paper prototyping phase, supported by design cards, and followed by an Arduino prototype phase. The purpose of the studio is also establishing a community of researchers and practitioners, from both academy and industry, interested in the field of tangible interaction with the Internet of Things.

Author Keywords
Internet of Things; Tangible Interaction properties; Interaction-Attention Continuum; Peripheral Interaction; Focused Interaction.

ACM Classification Keywords
H.5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous.

Introduction

The Internet of Things [4] is entering our daily routines through the increasing number of commercially available connected objects and devices. Such connected objects are able to collect an enormous quantity of information about our life and to offer us useful services. Most of such services are accessible at a tap of one finger through intuitive smartphone or web apps [10], thus poorly exploiting users' manipulative and cognitive skills. Within this context, a question arises: "can we design richer interaction experiences with IoT objects, exploiting the affordances of the physical world, instead of constraining users in the digital bubbles created by smartphones?". Recently, some researchers [1, 2] are arguing that tangible interaction properties can be beneficial to supporting richer and long-lasting interactions with IoT objects. Angelini et al. adopted the term Internet of Tangible Things (IoTT) for promoting a paradigm switch to the interaction design with IoT [2, 3]. In particular, we believe that the hybrid nature of tangible interaction [8] can be exploited to improve the user experience with IoT, enabling either immediate interactions that happen in the periphery of users' attention or more focused interactions that stimulate users' reflections. To this purpose, in this workshop, we build on the recent concept of the interaction-attention continuum [5] to frame the design space of tangible interaction with IoT.

Studio Proposal

The studio aims at gathering practitioners and researchers (10 to 18 participants) from both academy and industry, interested in the design of the interaction with the IoT. We aim at gathering people with different backgrounds (e.g., social sciences, computer science, psychology, design, future studies, etc.), creating groups of 3-4 people with heterogeneous skills, in order to encourage ideas and knowledge sharing from different perspectives. No particular skills are required for the studio: we will take care that each group will have at least one participant with technical skills. The studio will allow participants to explore the design space of tangible interaction with IoT objects, focusing in particular on the design of interactions for the full interaction-attention continuum. The studio will also allocate time for plenary discussions, allowing participants to know each other better and to get mutual knowledge of ongoing research, for networking purposes.

The hands-on activities will be carried out in different phases, following a methodology already tested in a workshop conducted during the 3rd European Tangible Interaction Studio [3]. The workshop will be split in two parts. During the first part, participants will develop an idea of a tangible IoT object through storyboarding and paper prototyping. During this phase, design cards will be used to support a structured reflection on how to exploit the full interaction-attention continuum for the interaction with tangible IoT objects. The card set used in this workshop will be derived from the card set already used in the previous workshop [3] and will include tangible interaction properties that span across the full interaction attention continuum (cf. [2] for a complete list) and IoT properties that can be embodied in the tangible interface. During the second part, through Arduino prototyping, the participants will develop one or more tangible IoT objects. By implementing the idea generated during the first part of the workshop, they will eventually reuse, improve and adapt the paper prototype previously created. A various range of sensors and actuators to be connected to the

Arduino will be provided to the participants, together with implementation examples for each tangible interaction property. Each example will include the necessary hardware material, the assembling instructions and the sample code.

At the end of each phase, each group will present the results of the idea generation, how they tried to explore the full interaction-attention continuum and which benefits this could bring for the end-user of the designed IoT object(s). In particular, we will ask to the participants to depict where the designed interactions and the corresponding tangible interaction properties situate in the full interaction-attention continuum.

Studio Topics to be Covered

Topics to be covered in this workshop are related to tangible interaction with the Internet of Things. A list of tangible interaction properties for IoT has been elicited in [2]. Among others, the following tangible interaction properties will be explored, ordered in the interaction-attention continuum from the less to the most attention demanding:

- *Peripheral interaction:* Peripheral interaction [6] is a relatively new field of research in HCI that try to promote interactions that happen in the periphery of the user's attention. In this manner, digital interaction with IoT objects could be effectuated during daily routines, without disrupting the attention from primary tasks.
- *Intuitiveness and immediacy*: Tangible interaction is often considered as a natural interaction means thanks to the easiness to learn and thanks to the intuitive affordances provided by physical objects and users' knowledge of basic physics principles [9]. This could be particularly useful to simplify the understanding of the complex behavior of some IoT objects.
- *Reflection and memories*: Particular IoT objects can stimulate reflection, boasting unexpected behaviors that would catch the attention of the user. Object physicality can also help for memory recollection [12], especially if IoT capabilities are associated to souvenirs or personal items.
- *Long-lasting interactions and emotional bonding*: Some IoT objects can benefit of life-like behaviors [11] to create an emotional bonding with the user and ensure long-lasting interactions thank, overcoming technological obsolescence and waste [7].

Studio Learning Goals / Discussion Objectives

The activities carried out during the workshop are focused on the exploration of the design space of tangible interaction with the Internet of Things, with a particular focus on the exploration of the full interaction-attention continuum. The purpose of the workshop is promoting the discussion in small groups, reasoning on a practical case during the different phases of the IoT object design, from the idea generation of the IoT object, to the physical paper embodiment and hardware implementation. Through the hands-on activity, we strive to promote a learning-by-doing process. Results of this process will be discussed at the end of the studio, to individuate common ideas that can be applied to the design of different IoT objects. In particular, we want to focus participants' reflections on how would be possible the design of tangible interactions that can span across different levels of the users' attention.

Moreover, through this workshop, we aim at gathering and establishing a community of researchers and practitioners with different backgrounds, interested in discussing the theoretical opportunities and challenges of tangible interaction applied to IoT and possible practical applications of tangible interfaces for IoT. At the beginning of the workshop, participants will briefly present themselves and their research, in order to facilitate connection and exchanges between workshop participants and support future connections and collaborations.

Studio Supporting Web Documents

A dedicated website will provide all the relevant information to the participants and will host materials (such as tutorials and Arduino code samples) for the studio participants. The website will be a point of reference for the community and will publicize other future events on the topic of tangible interaction with the IoT.

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