
Interactive Nature: using tangibles for nature exploration by children

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ABSTRACT

This paper illustrates the motivations and some initial results of our research on interactive tangibles for children and outdoor environments. We exploit tangibles to motivate children to go outdoor, play with nature and socialize with other children. The paper shortly illustrates the design and evaluation of two of such tangibles.

KEYWORDS:

Outdoor Exploration; Pervasive Games; Smart Object Design; Tangible; Children.

INTRODUCTION AND MOTIVATIONS

Technology has become a fundamental ingredient of our life. We live in a society where different kinds of digital devices support many of our activities. Not only adults, but also children use technology each day extensively [15]. Some studies assessed that this new digital context offers opportunities for children but it also generates a tension between the increased media-literacy skills and the reduced attitude towards exploring and interacting with the surrounding natural world [1][8].

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Figure 1: The ABBOT game combines a tangible object to play outdoors, with a mobile app to access new content related to the discovered natural elements.



Figure 2: Using the smart object to capture images on nature material.



Figure 3: Playing with the collected digital materials by getting close the cups of ABBOT devices.

Indeed, smartphones and tablets are becoming a sometimes-abused way to entertain children, forgetting that the natural world is a rich and positive resource for the kids' growth and personal development. Recently, some works have been focusing on the domain of nature exploration, and more specifically on the problem of exploiting mobile technologies to enhance the time and experience of users in nature [7]. A number of digital systems use mobile phones/tablets as intermediaries for nature exploration [1][4][7][15][16]. In contrast, the primary goal of our research is to motivate children to experience nature directly, through a transparent use of technology, i.e., without letting them being distracted by contents displayed on a screen [2][12][13]. So-called *Head-Up Games* (HUGs) [13][15] have initiated a trend towards exploiting *unobtrusive* smart objects to let children focus on the physical aspects of the real world [9][14]. Differently than games that use mobile devices as gaming interfaces, HUGs exploit embedded gaming technologies that do not force the players to attend to a screen and fit seamlessly into play, thus encouraging physical activity and social engagement.

Along this line of action, we have been designing a family of smart objects, in the form of tangibles, to stimulate children's curiosity for the natural world by combining open-air activities with digital ones, each one amplifying the effectiveness of the other. Our tangibles intentionally do not use any screen-equipped device as we aim to make children focus on natural elements when they are outdoors, without any kind of mediation through digital content. The adoption of unobtrusive smart objects is expected to foster emotional engagement and, in the long run, to positively affect kids' attitude towards nature, learning and understanding [17]. Also, physical manipulation provides an additional channel for information gathering that activates real-world knowledge and improves memory [10]. The study reported in [3] indeed highlights that, in order to design interactive tools that really motivate children to play outdoors, essential factors are the direct interaction with nature elements (e.g., plants and animals), as well as allowing children to play and collaborate with others.

In the following we illustrate how we tried to address the aspects highlighted above through the design of two interactive games: ABBOT and GAIA.

ABBOT: EXPLORING AND COLLECTING NATURE MATERIAL

Given the general goal of our research, we conducted an elicitation study with dozen of kids and their parents in parks and playgrounds in Milan. We wanted to understand in which measure kids love to go outdoors, which activities they love to have in the open air, and also if and how technology could be used to motivate children, still adhering to our intent of keeping it "invisible" during the outdoor exploration phase. Based on the collected requirements, we designed a first interactive playful game namely, ABBOT [4] (see Figures 1-4).



Figure 4: GAIA is a tangible band to be tied on a tree or any other element in a park (e.g., street lamps). It embeds four bright buttons and two speakers. Children interact with the device through lights, sound and touch. GAIA tells stories that guide children in a treasure hunt that leads them to explore the nature.

ABBOT is centered on the use of a tangible that enables kids to take pictures of their findings during environment exploration. ABBOT also records such pictures in a digital collection of materials. The tangible embeds a microcontroller with an accelerometer; the shaking of the tangible activates a camera that takes pictures. The top spherical cap shows the main color of the photographed material, a feature appealing for young kids.

When at home, together with parents, kids can play with the digital materials collected during outdoor activities. Simple interactive games on a tablet invite them to revisit what they discovered outdoor and match their photos with images proposed by the system. Related multimedia content explaining the main characteristics of their discovery is then presented for educational purposes.

GAIA: GET OUT AND INTERACT!

A study involving children of the elementary school [4] showed that ABBOT is effective in engaging and motivating children to explore outdoors. However, one of the identified limits was that each child needs to have her/his own device, so ABBOT might become exclusive: ABBOT facilitated nature exploration by a single child. Therefore ABBOT alone does not seem able to positively affect the social skills it aimed to elicit. To overcome such a limitation, we developed a new device, namely, GAIA. This can be installed outdoors on top of outdoor elements (for example trees or even street lamps in parks), and it fosters the involvement of groups of children. Like ABBOT, also GAIA has got no displays. As shown in Figure 4, it consists of a band with four bright buttons and two speakers whose functioning is managed by an embedded microcontroller. Sounds and lights are meant to attract children. If buttons are touched, GAIA tells stories that guide all children in a treasure hunt asking them to look for nature elements (a specific plant species, an animal). While solving the game together, children are led to explore the nature around them.

By combining the behaviors of GAIA components, it is possible to define a high number of flows of interaction. In a focus group that we conducted with some teachers of an elementary school, it emerged that the device can enable many kinds of activities, even indoors. Indeed, even if our main idea is to use GAIA to encourage children to play outside, the teachers pointed out that, thanks to the multisensory stimuli that the device is able to generate, it can be used also for educative purpose inside schools (e.g., enforcing the relation between mental processes and motoric processes), as well as by healthcare institutions assisting people with disabilities.

In general, the teachers embraced positively the GAIA idea, even those who in the initial part of the discussion expressed some doubts on the use of technology to explore the natural world (*"If used in this way, technology can be a nice solution!"*). As an interesting result, teachers led us identify the value of the device as a support for "structured activities", not simply as an object to be set in a park

permanently for free use by children.

We also observed some pupils of an elementary school while using GAIA for playing in the school garden. We are still in the process of analyzing the data that we gathered through audio-video recordings and a questionnaire based on the Fun Toolkit survey method [11]. However, we observed that the tangible engaged them very much: they were fascinated by its lights (*"They look like a rainbow!"*) and by sounds. All looked very involved in the treasure hunt. They often run from a tree to another, in some cases even without listening at the game quest that should guide them to look for the next nature element. If on one side this aspect can be ascribed to a lack of clarity of the story told by the device, at the same time it can be interpreted as a positive evidence for the children's engagement in the exploration of the environment with GAIA. The most interesting point that we observed was the children's willingness, stimulated by the GAIA experience, to continue exploring the nature even after the end of the game.

CONCLUSIONS

By illustrating the design of two interactive tangibles, we have outlined our vision on exploiting technologies for motivating children to go outdoor and explore nature. Our interest is on how computing can enhance, enable, and encourage outdoor exploration, while respecting the priority that children-nature interaction and exploration of nature should take over the interaction with technology outdoors.

As a continuation of our work, we will extend the devices we have designed so far with new capabilities, for example voice recognition for both ABBOT and GAIA, as well as additional sensors that can make GAIA responsive to proximity and motion. We will also conduct new studies to verify the effectiveness of these new features and take inspiration for new ideas on technology-enhanced paradigms for nature exploration. Future work will be also devoted to the development of an intuitive composition paradigm that can empower even non-technical stakeholders to combine flexibly the different capabilities of our devices to create customizable game experiences.

So far, children were only involved as design informant in our research. The next step is to involve them as co-designers. To this end, we are working on a board game for co-designing solutions like ABBOT and GAIA with children.

Given the activities that we have conducted so far, and the ones that we have planned as future work, it would be interesting to share our ideas with other researchers that are active in the field of outdoor play. Participating to the workshop would give us the opportunity to get relevant feedback and identify new challenges. We also aim to establish collaborations: given the impact that this research theme can have on society, it is extremely important to create a community of experts working on it, reflecting on challenges, and identifying impactful solutions.

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