Device Design for Learning Using Place, Intuitive Behaviour and Collaboration *

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As part of the U.K. Equator IRC, a multidisciplinary group of researchers have collaborated in the design of digitally augmented environments with the intention of addressing the question of how such augmentation supports learning about, and interaction with, the environment. A number of innovative play and learning environments have been developed to explore ways in which ubiquitous technologies can support effective, imaginative and engaging interaction for children. These scenarios range from indoor settings to field trips into the countryside [1] . They involved both audio and visual media used with innovative devices, each presenting particular challenges and design opportunities. In this paper we first briefly describe our experiences in the 'Ambient Wood', then discuss a related framework [2] which has been applied to the further development of this work, and finally discuss it's relevance to the concepts of 'UbiPhysics'.

1 Ambient Wood

The Ambient Wood was a digitally augmented learning experience designed to support 11-12 year old children learning about habitat distributions and interdependencies. The experience was designed to encourage children to engage in scientific enquiry by providing them with novel ways of integrating different kinds of knowledge through digital and physical experiences. Pairs of children equipped with a number of devices collaboratively explored different parts of a Sussex woodland. The experience was designed to stimulate inquiry by creating events that are unexpected causing the children to pay attention, wonder why and question outcomes. It was also designed to draw the children's attention to important factors and processes of the environment that they would not normally discover through exploring the physical world with naked ear and eye. For example, by measuring actual humidity and light levels and listening to located audio representing plant growth, invisible processes such as photosynthesis were revealed.

The physical environment was prepared with RF location beacons, or 'pingers', and a WiFi network. A variety of audio devices and multi-modal displays were

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used to present the added digital information, sometimes triggered by the children's exploratory movements, and at other times determined by their intentional actions. A field trip with a difference was thus created where children discover, hypothesize about, and experiment with biological processes taking place within the physical environment.

2 Design Framework for Tangible Interaction

As part of progressing this work we have examined the Ambient Wood project in the context of a framework structured around several themes [2]. These themes have particular relevance to our work and have offered interesting perspectives on the project.

The **Spatial Interaction Theme** considers location and movement in space as inherent elements of interaction. The user's body is the central reference point for perception, which is tightly coupled with movement. We humans tend to interpret spatial qualities (or the positioning of objects) in relation to our own body. Spatial configurations therefore have psychological meaning. Real space is always inhabited and situated, becoming 'place'.

The **Embodied Facilitation Theme** considers how physical space and system space (software) determine and guide behaviour by imposing structure which allows, directs, and limits behaviour, determining usage options and behaviour patterns. Thus these structures shape the ways we collaborate, they invite collaboration, or make us refrain. One of the concepts of this theme that we found potentially relevant for our application context is *Embodied Constraints*. It is best summarised in the colloquial language question: does the physical set-up lead users to collaborate by subtly constraining their behaviour? Embodied constraints refer to the physical system set-up, or configuration of space and objects, that can guide some types of activity, or simply limit what people can do.

Tangible Manipulation considers bodily interaction with physical objects. This type of interaction is observable and allows for implicit communication and peripheral awareness. Tangible manipulation also focuses on the material qualities of artefacts and their responses to interaction. The **Performative Action** concept relates both to spatial interaction and tangible manipulation. Manipulating devices in real space is observable and thus can create a performance. If the devices are large, interaction is even more performative, because the devices themselves are better visible and amplify the user's movements.

Expressive Representation considers the relation of digital and physical representations and how these are 'read' by users and acted upon. Good representations are legible, expressive, easy to create and manipulate. Hybrid representations combine digital and physical elements, coupled in an understandable way, which can resort to magical metapors or make-believe causal effects.

We will use these to reflect in particular on the design and use of a located audio player device, the Ambient Horn, as used in Ambient Wood.

3 Discussion

In our work in the Ambient Wood we have previously investigated the use of place and collaboration as ways to promote reflection and learning using digitally augmented environments. We observed, however that children would appropriate the devices in unexpected and interesting ways. For example, the Ambient Horn device was designed so that a light would flash when children were near a pinger, and they could then choose to listen to a sound on the horn that represented some otherwise imperceptible process in the wood e.g. photosynthesis. The shape and size of the horn enabled performative actions, often in collaboration, for stopping and listening to it together. Interestingly though, children also tried to use it as if it was a recording device able to 'scoop' up sounds. The children were very aware of being bodily located in a physical space where they were being asked to understand the local ecology; the shape of the horn and its playing of 'digital' sound was interpreted within this physical space as also being able to capture physical sounds using imaginative gestures.

Using ideas derived from a combination of the Embodied Facilitation theme, Tangible Manipulation and Expressive Representation, this leads us to reflect on the design of the horn within this broader framework (not just as a physical device for delivering audio content) and think about how we can give devices greater functionality to promote transformation and re-representation of physical activity and thus further enhance the learning experience. This could be achieved with a mix of fake/make-believe causal feedback facilitated by allowing users to grab, feel and move both virtual and real content, taking account of embodied facilitation. A key aspect of this will be to provide legibility and expressiveness in the device as well as in the interaction (interpreted by employing movement sensors to track gesture). Legible device state (e.g. being in audio recording mode) allows bystanders to adjust to the situation, circumventing the device carrier, or to deliberately engage in the situation (e.g. in a role play).

We recognise that place and collaboration are of primary importance, but wish to pursue our understanding of how movement and physical representation can assist with interaction and learning by using novel devices in augmented environments. We aim to use both the analysis from the Ambient Wood experience, and the reflection against the perspectives offered by this framework, to develop new forms of experiences that better integrate the 'ubiphysics' of the devices within the usage context.

References

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