Exploiting Physicality: linking action and effect

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If the real world becomes the user interface, in what ways can we use it to create new forms of interaction? We are interested in how novel technologies might be used to support learning, specifically in the cognitive benefits of using one kind of interface or another. Two approaches that have been taken are the tangibles approach, where objects in the real world can be digitally augmented and manipulated to produce digital effects, and sensor-based interaction, where people in the real world can be identified and tracked, and serve as the trigger themselves for digital events to take place. From a technical perspective these two approaches have much in common: sensors are used to track the location or state of an object or person, and this information is used to send information relevant to that state or location. However, the benefit in terms of users' understanding of these systems is as yet unclear.

A number of theorists have argued that productive learning can result from a cycle between engaged situated action [2] and more objective reflection [1, 4]. Intuitively, it might be expected that real world interfaces could support this type of learning well: the learner's primary focus can be on the real world, providing the facility to really contextualise learning, but at the same time to augment and enhance it, providing reflection prompts or further information in a timely fashion.

An interesting issue that we perceive is in how readily the learner understands the link between physical action and digital effect. Learners may less readily understand the link when it is triggered by a change in location in a large-scale environment, than by, for example, manipulating an object on a table-top tangible interface. As part of the Ambient Wood project, which aimed to explore the potential of technology to augment the information available on an ecology field trip [3], we investigated some of the issues related to this question.

Initially we had envisaged delivering information about local flora and fauna to children engaged in exploring a large-scale woodland environment via handheld computers [3]. However, it became apparent in a trial run of the experience that children did not readily make the link between information presented to them and the real objects in the world: simply because the children were standing next to a tree in the wood didn't mean that they were currently interested in that tree, and the information delivered to the handheld relating to it was frequently ignored.

This paper was presented at "Physical Interaction (PI03) – Workshop on Real World User Interfaces", a workshop at the Mobile HCI Conference 2003 in Udine (Italy). September 8, 2003.
Further information and online proceedings are available at http://www.medien.informatik.uni-muenchen.de/en/events/pi03/

In contrast, a probe tool designed to allow the children to measure light and moisture levels in the wood allowed a more direct and active link between physical action and digital effect (an abstract representation of light or moisture level). By recording the location where each reading was taken, we were also able to present children with a representation of the readings taken in different habitats in the wood, allowing comparison and facilitating reflection about the about the relationships between light and moisture levels and the local plant life. Thus, the relationship between physical action and digital effect occurred at two distinct levels with this tool. Immediate feedback while using the probe seemed to encourage greater levels of exploration, while the delayed feedback showing all readings together promoted reflective thought and discussion between the kids.

We pose the following questions for discussion:

- From a cognitive perspective, in what circumstances might it be beneficial for a learner to knowingly (deliberately) trigger an effect, and in what circumstances might an unknown trigger be beneficial?
- How might information more relevant to a learner's focus of attention be delivered in an exploratory activity?

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