

ACCESS

Designing Interactive Systems

People, Activities, Contexts, Technologies

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and Susan Turner

Note:

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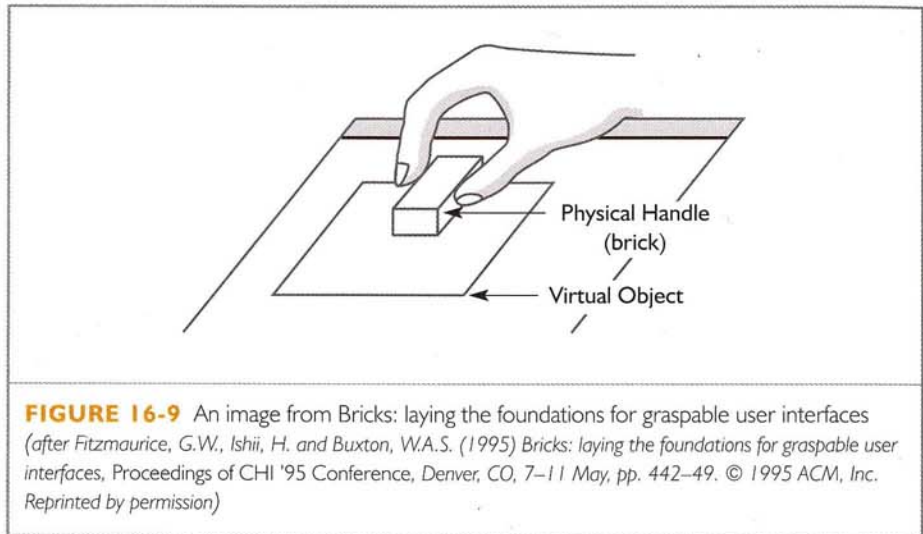


 ADDISON-WESLEY

5th (2nd, 4th...)

2-dimensional Lay

With this system, as can be seen in Figure 16-9, a brick or group of bricks act as the handles of the corresponding virtual object. The bricks are tightly coupled with the corresponding digital objects. Moving the physical brick moves the virtual object; rotating the brick rotates the virtual object.



A key technical challenge for TUIs lies with tracking the positions of the physical representations themselves and reflecting those changes in the virtual (digital) representation. In the Bricks system Ascension Flock of Birds, 6D input devices were to simulate the graspable objects. Each receiver is a small 1-inch cube that constantly sends positional and orientation information to a high-end workstation.

illuminating Clay

illuminating Clay is an interesting, though specialist example of tangible computing. It is a later and much more sophisticated implementation than Bricks but essentially builds on the same underlying principles. illuminating Clay is introduced and placed in context by its creators with the following scenario:

'A group of road builders, environment engineers and landscape designers stand at an ordinary table on which is placed a clay model of a particular site in the landscape. Their task is to design the course of a new roadway, housing complex and parking area that will satisfy engineering, environmental and aesthetic requirements. Using her finger the engineer flattens out the side of a hill in the model to provide a flat plane for an area for car parking As she does so an area of yellow illumination appears in another part of the model. The environmental engineer points out that this indicates a region of possible landslide caused by the change in the terrain and resulting flow of water. The landscape designer suggests that this

landslide could be avoided by adding a raised earth mound around the car park. The group tests the hypothesis by adding material to the model and all three observe the resulting effect on the stability of the slope.

Piper, Ratti and Ishii (2002)

In the Illuminating Clay system, the physical, tangible objects are made of clay. Piper *et al.* (2002) experimented with several different types of modelling material including Lego blocks, modelling clay, Plasticine, Silly Putty and so on. Eventually they found that a thin layer of Plasticine supported by a metal mesh core worked best. This clay was then shaped into the desired form by the landscape specialists (see Figure 16-10). The matte white finish also proved to be highly suitable as a projection surface onto which the digital elements of the system were projected. Ordinarily, people working with landscapes would create complex models using computer aided design (CAD) software and then run simulations to examine, for instance, the effects of wind flow, drainage and the position of powerlines and roads. With Illuminating Clay, the potential consequences of the landscape are projected directly (for example, as in the scenario above a patch of coloured light) onto the clay itself.

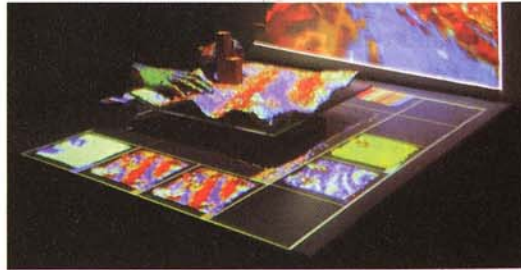


FIGURE 16-10 An image from Illuminating Clay
 (source: Piper, B., Ratti, C. and Ishii, H. (2002) *Illuminating Clay: a 3D tangible interface for landscape analysis*, Proceedings of CHI '02 Conference, Minneapolis, MN, 20–25 April, pp. 355–62. © ACM, Inc. Reprinted by permission)

The coupling between clay and its digital representation is managed by means of a ceiling-mounted laser scanner and digital projector. Using an angled mirror the scanner and projector are aligned at the same optical origin and the two devices are calibrated to scan and project over an equal area. This configuration ensures that all the surfaces that are visible to the scanner can also be projected upon.

Thus Illuminating Clay demonstrates the advantages of combining physical and digital representations for landscape analysis. The physical clay model conveys spatial relationships that can be directly manipulated by the user's hands. This approach allows users to quickly create and understand highly complex topographies that would be time-consuming using conventional CAD tools.

**Challenge 16-4**

Suggest other application areas where Illuminating Clay may be useful.

16.10 Interactive workbenches

Interactive workbenches are a group of related technologies which track the position and movements of objects on a flat 'tabletop'. The workbenches are interactive in that they respond to user input with a graphical response (or output). A number of these prototype systems have been developed and include Bricks (Fitzmaurice *et al.*, 1995), described above, DigitalDesk (Wellner, 1993), SenseTable (Patten *et al.*, 2001) and Urp (Underkoffler and Ishii, 1999). The Actuated Workbench developed by Pangaro *et al.* (2002) is described in a little detail below.

The Actuated Workbench

Pangaro, Maynes-Aminzade and Ishii (2002) from the MIT Media Lab have built and described a system they have called the Actuated Workbench (AW). The AW is a device that uses an array of magnets to move objects on a table in two dimensions. It is intended for use with existing tabletop tangible interfaces, providing an additional feedback loop for computer output, and helping to resolve inconsistencies that otherwise arise from the computer's inability to move objects on the table. Other interactive workbenches are primarily input devices. Users are able to manipulate objects on the 'tabletop' which are reflected in changes in a corresponding digital object. This is fine for input, but output in such cases tends to be limited to a sound or change in the accompanying visual display. The Actuated Workbench is different in that it physically moves the objects on the tabletop by manipulating an array of magnets hidden below. See Figures 16-11 and 16-12. A schematic view of how this works is reproduced in Figure 16-13. The technical complexity of these workbenches is not to be underestimated.

16.11 Wearable computing

Most of us encounter computers on desktops in offices or at college. We also find computers (as games consoles) in the bedrooms of teenagers, in the pockets of the white coat of a clinician (as a PDA – personal data assistant) and in all manner of household devices (as microprocessors in washing machines, microwaves, DVD players and so forth). We do not, however, often find computers