Camping in the digital wilderness: tents and flashlights as interfaces to virtual worlds

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ABSTRACT
A projection screen in the shape of a tent provides children with a shared immersive experience of a virtual world based on the metaphor of camping. RFID aerials at its entrances sense tagged children and objects as they enter and leave. Video tracking allows multiple flashlights to be used as pointing devices. The tent is an example of a traversable interface, designed for deployment in public spaces such as museums, galleries and classrooms.

Keywords
Virtual environments, immersive and traversable interfaces, RFID, video tracking, single display groupware

INTRODUCTION
Pitching a tent and spending the night under canvass, with friends, a rucksack, a flashlight, surrounded by strange shadows and sounds, is an exciting experience for most children. It is also often the closest that many come to the wilderness, a primitive unfamiliar place that is far removed from their everyday world. What better environment is there for experiencing stories?

Previous research reported at CHI has discussed using a tent as a projection interface for ambient and informal experiences [5]. This paper explores the use of a tent interface to give young children an engaging and shared experience of a virtual world, targeted at public spaces such as museums, theme parks and classrooms.

THE OVERALL DESIGN OF THE TENT
Our tent consists of a fabric projection screen stretched over a lightweight aluminum tubing frame to mimic the shape of a classic A-frame tent (figure 1). Two projectors outside the tent project views of a common 3D virtual world onto each side of this structure. These are positioned and synchronised (using the MASSIVE distributed VR system) so that those inside appear to be looking out in a 3D virtual world. Initial work has focused on interactions that fit naturally with the tent metaphor.

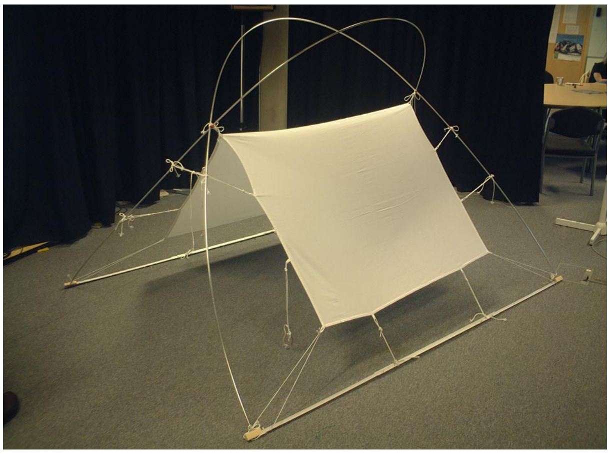

Figure 1: The structure of the tent

POINTING WITH FLASHLIGHTS
Our first interaction technique employs flashlights, essential items of camping equipment, as pointing devices (figure 2). Video cameras placed alongside the projectors track the positions of beams of light thrown onto the surface of the tent from inside and outside. The tracking system is calibrated by manually indicating on an image of the tent the four corners of the projected display. Beams are detected by thresholding image intensity values (following [1]). Given the last known position and velocity of each beam, the tracker predicts the location of the centre of that beam in the incoming frame. Corresponding beams are then sought in the area around each prediction. If more than one candidate is identified a refined search, exploiting velocity estimates, is performed. This allows beams to pass close to and even overlap each other without being confused. The tracker can follow several beams simultaneously with an update rate of 30Hz. To date, the tracking system has been tested with up to six simultaneous flashlights, opening up new possibilities for collaborative interaction.

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This style of interaction is suited to direct manipulation of virtual objects. In early tests, flashlights were used to attract and steer virtual balloons. These tests revealed a problem in that children outside the tent would occasionally obscure the camera's view of the flashlight beam, making tracking impossible. Mounting the camera on the projector so that the two have the same viewpoint may reduce any resulting confusion, as a child obscuring the camera will also cast a shadow onto the tent to obscure the object being controlled.

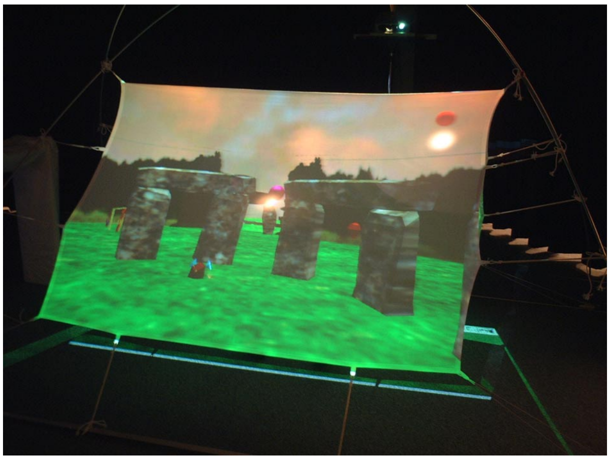

Figure 2: Using two flashlights as interaction devices

RECOGNISING TRAVERSALS

Our second kind of interaction involves the tent sensing the passage of children and physical objects as they enter or leave its structure. The children's clothing and the objects in question are tagged with high frequency (13.56 MHz) RFID tags. A tag reader with extended aerials is placed at the tent entrances to detect passing tags. Reading a specific tag sends a message to the MASSIVE software that then triggers an effect in the virtual world, for example adding or removing virtual characters. The physical objects might be regular items of camping equipment or might be objects that the children have found in another part of the experience. For example, children on a virtual field trip might collect historical artefacts. Taking these back to the tent would then transport them to different locations and times in history.

Unlike some applications of RFID tagging where there is a relatively predictable style of use (e.g., where objects are placed directly on a surface), the passage of children and objects through the tent is much less predictable. Children may crawl at different speeds and in different positions. Objects may be carried in hands, pockets or bags, or may even be thrown. Early tests revealed problems with the power and range of aerials, especially when placed on the floor as well as sensitivity to the orientation of tags. Our solution has been to design an entrance consisting of two vertical aerials (one powered, one reflective) built into a gateway and to attach multiple tags in orthogonal orientations to children and objects.

THE TENT AS HCI

As an interface, the tent reflects several current concerns within HCI. First, it represents an example of a traversable interface that provides the illusion of crossing into and out of a virtual world. Previous examples have included fabric curtains, sliding doors, hinged screens and even water sprays [3]. The tent demonstrates an alternative in which participants enter a space that is defined by the screen, but where unlike CAVE-style immersive interfaces, the space outside the screen is also part of the experience.

Second, supporting effective collaboration has been a concern for the designers of children's storytelling technologies. Possible solutions include the use of single display groupware with multiple input devices [4], or room size projection systems combined with physical and tangible interfaces [2]. Both of the interaction styles described here meet this requirement in a way that is inexpensive and easy to configure (adding a new flashlight requires no changes to the hardware or software).

Finally, our design tries to meet some of the challenges of designing interfaces for public spaces. For example, studies of interactive exhibits in museums show how passers-by learn by watching others interact [6]. The two-sided nature of the tent provides those outside with a public rendition of the activity that is happening inside, but at the same time maintains a relatively protected and isolated environment for those inside.

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