Untethered Force Feedback Interface That Uses Air Jets.

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Abstract

We introduce an untethered interface that eliminates the annoyance of wires etc. by using air-jets to establish force feedback. Attendees experience interaction with a virtual object that responds to being "touched". The sense of touch is provided by air-jets while visual clues are provided by a projection-based stereo display.

1 Motivation

Virtual Reality (VR) technology has a lot of potential to enrich daily life. Force feedback is a key technology to making VR systems more realistic and acceptable since the user fuses the physical sensation of touch with the sensation of vision to make the virtual objects come to life.

Many of the devices [Massie et al.,1994; Virtual Technologies, Inc.] created to realize force feedback demand the use of connecting wires and /or demand that a heavy device be worn; both of which disturb the user's free movement, and raise the level of annoyance. Compared to the tools used in daily life, existing VR systems leave a lot to be desired. We focus on the acceptance of VR systems, so we concentrate on eliminating anything that restrains the user; a tool will not become part of daily life if it is seen as an encumbrance. Our keyword is "Untethered".

2 Air-pressure-based Force Feedback

The major component of our system is the force feedback interface. The basic idea of this method is that air released from a jet impacts the "air receiver" (paddle) held by the user to provide force feedback. The user perceives the air pressure as force and so it feels as if he/she is touching the object. The demonstration system uses a 2D array of air jets that point upwards to create the feel of touching three dimensional virtual objects. The system detects the air receiver's position, determines if it is "contacting" the surface of a virtual object in the virtual space, and if contact exists, releases air from the nozzle immediately under the air receiver. The release of air is continued until the air receiver is removed from the surface or is moved to a new position on the surface. In the latter case, the system releases air from the next appropriate nozzle. This sequential release of air provides the user with the feeling of continuity when touching a 3D object. The implementation system uses 100 air-jets nozzles arranged in a 10x10 array that is embedded in a desk.

The second component is the projection-based stereo display system. In the demonstration system, the stereo images are projected onto the top surface of the desk. The black air jet holes on the top surface of the desk are covered with simple flaps so that the stereo images projected on the desk are not degraded.

The third component is the optical position tracking system. The user's 3D glasses and the paddle have visual markers and their positions and orientations are detected by using two cameras.

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These three components realize a completely wire-free interface. The user simply puts on the lightweight 3D glasses and holds the lightweight paddle. The user is not prevented from moving freely within the system, and is never bothered by system operation. We would like to emphasize that the system to be demonstrated is completely devoid of user restraints.

In this demonstration, the attendees can interact with a virtual creature. The computer- generated virtual creature responds to being "touched" by the user. This interaction will intrigue any user.

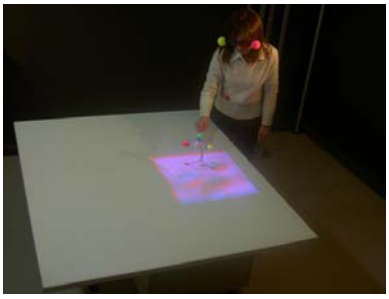

Figure 1: System in use.

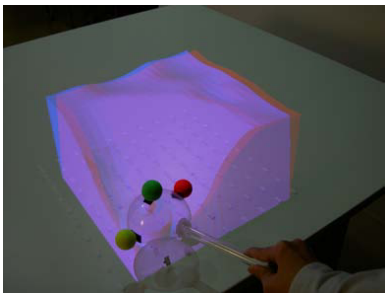

Figure 2: The virtual object.

Figure 3: 100 air-jet nozzles.

References

MASSIE, T. H., AND SALISBURY., J. K. 1994. The phantom haptic interface: A device for probing virtual objects. In *ASME Winter Annual Meeting*, vol. 55-1, 295-300.

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