VIRTUAL INTERFACE ENVIRONMENT

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Abstract

A head-mounted, wide-angle, stereoscopic display system controlled by operator position, voice and gesture is under development for use as a multipurpose interface environment. Initial applications of the system are in telerobotics, data-management and human factors research. System configuration and research directions are described.

1. Objective

The objective of this research effort is to develop a multisensory, interactive display system in which a user can virtually explore a 360-degree synthesized or remotely sensed environment and viscerally interact with its components. This work is done in the context of developing a multipurpose operator interface 'environment' to facilitate natural interaction with:

- Complex operational tasks such as control of remotely operated robotic devices and vehicles that require a sufficient quantity and quality of sensory feedback to approximate actual presence at the task site.

- Large-scale integrated information systems in which data manipulation, storage and retrieval and system monitoring tasks can be spatially organized.

An additional research objective includes use of this display system to synthesize interactive test environments for aerospace human factors research in such areas as: spatial habatability research, rapid prototyping of display and workstation configurations, research on effective transfer of spatial information, and spatial cognition research on multisensory integration.

2. System Configuration

The virtual environment display system consists of: a wide-angle stereoscopic display unit, glove-like devices for multiple degree-of-freedom tactile input, connected speech recognition technology, speech-synthesis technology, gesture tracking devices, and computer graphic and video image generation equipment.

The present display unit is helmet-mounted and consists of monochromatic liquid crystal display screens presented to each eye of the user through wide-angle optics. The effective field of view for each eye is 120 degrees for horizontal and vertical. Imagery displayed on the screen is generated by computer, remote video sources or a combination of input media. Head motion of the user is tracked by a sensor mounted on the helmet and the derived position and orientation data is used to update the displayed stereo images in response to the users activity. As a result the displayed imagery can appear to completely surround the user in 3-space.

To interact with the displayed three dimensional environment, the user wears lightweight glove-like devices that transmit data-records of arm, hand and finger shape and position to a host computer. In coordination with connected speech recognition technology, this information is used to effect indicated gestures in the synthesized or remote environment. Current examples of research in voice and gesture mediated interaction is the control of robotic arms and end-effectors, and associated control of auxillary camera positions. Similarly, in a data management environment, windows of information or virtual control panels are positioned, sized and activated in 3-space.
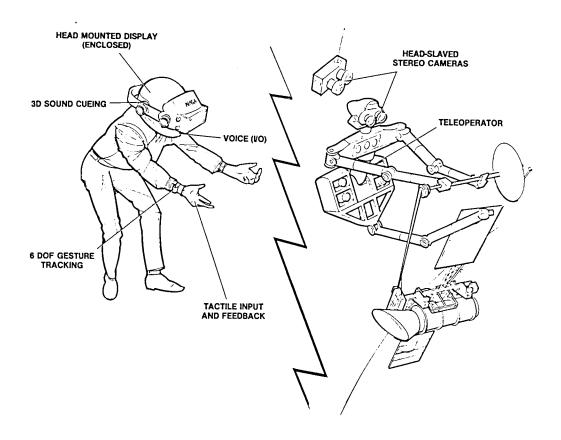
Current experimental research includes system calibration for orthoscopic image display, evaluation of operator performance in teleoperation placement tasks, and analysis of perceived localization of synthesized sound sources in 3-space.

3. Conclusions

Unlike most contemporary 360-degree visual simulation environments, the virtual environment display system does not make use of large, expensive, special purpose projection configurations; The described system is portable and low-cost without large space and equipment requirements. Unlike other research efforts in head-mounted displays, this system is unique in presenting a stereoscopic image that fills the user's field of view completely and in its configuration with speech and tactile input technology.

As a research tool, the virtual environment display system follows many research efforts to develop operator control stations for teleoperation and telepresence but has a unique configuration to investigate natural, multisensory interaction with complex operational tasks. As an interface for data management tasks, this system is a continuation of recent research in multimodal, natural input technology and concentrates on development of a true three dimensional data space interface that can be easily reconfigured for idiosyncratic users.

VIRTUAL INTERFACE ENVIRONMENT
TELEPRESENCE

HEAD MOUNTED DISPLAY
(ENCLOSED)

3D SOUND CUEING

VOICE (I/O)

HEAD-SLAVED
STEREO CAMERAS

TELEOPERATOR

6 DOF GESTURE
TRACKING

TACTILE INPUT
AND FEEDBACK

VIRTUAL INTERFACE ENVIRONMENT
SPACE STATION SYSTEMS AND DATA MANAGEMENT

HEAD MOUNTED DISPLAY
(SUPERPOSITION)

VIRTUAL CONTROL PANEL/
TELESCIENCE WORKSTATION

MULTISENSORY
DATA SPACE (360°)

3D SOUND CUEING

VOICE (I/O)

6 DOF GESTURE
TRACKING

TACTILE INPUT
AND FEEDBACK

87