DesignSpace

An exhibit of developing technologies

for design

DesignSpace exhibits a conceptual application of future design media drawn from work at Stanford University's Center for Design Research (CDR), that facilitates collaborative design between remote stations through a shared virtual space. CDR was founded in 1983 as an industry-academia collaborative and interdisciplinary R&D center to improve the engineering and product design process. The Center accepts design problems from industry and government, and confronts them with creative design teams, for the purpose of design process observation and study, experimental design practice, and new design tool development. A long-term CDR goal is to aid the design process so that problem complexity does not impede creativity, reuse of design knowledge, and human skill. While modern design tools make productive use of computer assistance, computer interfaces often interfere with the designer's creative thought flow and manual skills. To overcome these interferences, CDR researchers and designers collaborate on projects to develop devices and interfaces to better map manual skills to data operations, experiment with alternative means of design knowledge storage and retrieval, and investigate design tool effectiveness. **DesignSpace** encapsulates developing technologies from some of these CDR projects into a conceptual design environment.

DesignSpace exhibits four key emerging technologies, demonstrating either advances or unique applications by CDR: dexterous manipulation, virtual presence, telecommunication, and auditory display. Dexterous manipulation technology encompasses sensing, encoding, and interpretation both static poses and dynamic actions of the human operator to manipulate data in computer-based media. **DesignSpace** showcases the highest precision in both virtual hand space recognition and physical hand space representation. With hand space recognition, operators may control the environment or command the system with static and dynamic gestures. With accurate hand space representation, operators may skillfully manipulate virtual objects and controls. Virtual presence technology creates a consistent psychological effect that makes computer-based media believable and intuitive. Unlike an immersive virtual environment with a head-mounted display, which attempts to give the user a presence in a virtual place, **DesignSpace** attempts to give virtual objects a presence in the user's physical space. Telecommunication technology provides access to and transmission of remote information. **DesignSpace** uses three-dimensional visual and audio graphics to present remote individuals and objects, with an interactive viewpoint for selective information access, all within the bandwidth of a standard telephone line. Auditory display technology encodes information in auditory cues such as localization to present data uniquely, or to reinforce other sensory displays (commonly visual). **DesignSpace** supports multiple listeners sharing an acoustic environment with multiple dynamic, directional and spatially located audio sources.

Several CDR projects form the basis for **DesignSpace**:

- *Talking Glove* (J. Kramer and L. Leifer) - an assistive communication device for non-speaking deaf individuals, which recognizes American Sign Language (ASL) finger-spelling to generate text or synthesized speech. At the core of the *Talking Glove* system is an instrumented glove and neural net recognition algorithm for mapping dynamic hand formations into a digital command stream. Virtual Technologies

Center for Design Research, Stanford University, 560 Panama Street, Stanford, CA 94309-2232
William L. Chapin, chapin@cdr.stanford.edu, (415) 723-7908

further developed the patented technology into a hand instrumentation system called the Virtex CyberGlove™.

- *Cut Plane* (L. Edwards, W. Kessler, and L. Leifer) - a 3D CAD interaction metaphor, displacing the need for orthonormal projections, command line input, and menu command selection, while providing continuous access to all three dimensions on a standard CAD workstation with mouse. A CDR spinoff enterprise, Beyond Technologies, developed and implemented the *Cut Plane* metaphor in a conceptual design tool product called 3Form.
- *Virtual Hand* (W. Chapin and J. Kramer) - a dynamic simulated hand model driven by the instrumented glove developed for *Talking Glove*.
- *TeleSign* (W. Chapin, J. Kramer, E. Macken, C. Haas, and L. Leifer) - a collaborative design effort between CDR and the Center for the Study of Language and Information, leveraged from the *Talking Glove* and *Virtual Hand* projects to develop a system for visual expression and manual communication. Two or more *TeleSign* stations share a locally maintained virtual environment across standard low-bandwidth telephone channels.

At each **DesignSpace** station, a participating designer works in a physical studio environment, with access to one shared virtual 3D space. The "semi-immersive" aural, visual, and dexterous interaction within the virtual environment frees the user to work in both the physical and virtual design spaces. Hand and wrist instrumentation empowers each **DesignSpace** designer with system control, manual communication with collaborating designers, and use of dexterous design skills. Participants may use dexterous interaction to compose 3D MIDI music, create colorful 3D designs, communicate in a manual language, and modify the design environment, in addition to issuing pre-trained, macro-type system commands using hand gestures. Linked stations maintain the environment locally and bidirectionally share their participants' interactions. Diverging from traditional CAD tools, **DesignSpace** does not require the designer to channel design interaction through a command interface, and attempts to put creativity back in the "hands" of the designer. Being a "semi-immersive" virtual environment system, **DesignSpace** permits the use of traditional design media, such as paper or clay, while bringing computer-based design media into the design studio, virtually into the designer's hands, and extending the experience to remote collaborators.

While a major motivation to create a CDR exhibit was to suggest useful applications for these new technologies, the multi-faceted **DesignSpace** application inherently provides other values as well. Educationally, **DesignSpace** is a creative platform for students to experiment with assembling shapes and sounds. The system enables a wide range of fun, interactive activities for remote participants, exploiting dexterous skill in competition or collaboration. As a communication medium, **DesignSpace** increases social accessibility to ideas, concepts and emotions, and may provide more cultural depth and value than sense-deprived media such as print, the telephone or e-mail. The design intent behind the **DesignSpace** application is to provide industrial value within CDR's goals: to increase accessibility and productivity to computer aided design (CAD), to better communicate ideas between individuals, and to integrate interactive design, simulation, and testing into a single facility to expedite design iteration. The **DesignSpace** exhibit provides CDR the opportunity to test these new developments against their goals.

DesignSpace submitter:
William L. Chapin, CDR
chapin@cdr.stanford.edu (415) 725-0153

DesignSpace contributors:
Larry Leifer, CDR Director
leifer@cdr.stanford.edu (415) 725-0160
James Kramer, CDR
kramer@cdr.stanford.edu (415) 725-0153
Larry Edwards, CDR
edwards@cdr.stanford.edu (415) 725-0153

Center for Design Research, Stanford University, 560 Panama Street, Stanford, CA 94309-2232
William L. Chapin, chapin@cdr.stanford.edu, (415) 723-7908