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CREATING BETTER VIRTUAL WORLDS

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INTRODUCTION

Computing machines have brought new opportunities as well as challenges to our information age. While computer capacities and speeds have increased remarkably, our ability to communicate with these information engines is still limited by poor interfaces between the human and the computer. To harness and exploit the power of the computer as a tool and extender of our intellect, it is essential that we build new interfaces which are intuitive, transparent and take advantage of our innate spatial abilities.

The new technology of virtual interfaces provides a revolutionary way to improve the coupling of the human to the computing machine. Virtual controls and displays allow panoramic presentations in three dimensions to be made to the eyes, ears and hands of the user by projecting "virtual" images into the senses. To gain this global experience "the human literally wears the computer." Virtual interfaces transfer stimuli to the eyes, ears and hands, and use head, eye, hand movement and speech to control the machine. In this way the operator can be surrounded by a "circumambience" of computer synthesized information which becomes a spatial world through which he and machine can effectively communicate. The operator, in turn, interacts with his global medium by looking at objects, pointing his hands and giving verbal commands. The medium also allows virtual objects, which appear to be real but which are virtual projections, to be touched and manipulated by the hands. In order to create the virtual space representation of information, the virtual display hardware components are programmed with "mindware." Mindware is a special class of software that takes into account the perceptual organization of the human and dynamically creates three-dimensional sound, video and tactile images which appear as an artificial reality surrounding the user.

The virtual interfaces described above not only solve many existing interface problems but empower new and novel interfaces for operators in aerospace vehicles and other applications such as teleoperation, computer-aided design, medical imaging, prostheses for the handicapped and entertainment. Even though some aspects of virtual interface technology have been under development for two decades, there are still several key problems which must be addressed and resolved to make these concepts practical for research, industrial and consumer applications. These problems are summarized below:

THE PROBLEMS

1. We don't understand the human factors of virtual space.
2. We don't know how to measure the "goodness" of virtual worlds.
3. Except for the more expensive military versions, virtual displays lack sufficient resolution for wide field-of-view presentations.
4. Position sensing technology (for control and image stabilization) needs improvement to increase precision and update rate while reducing noise and sensitivity to conductive materials.
5. Current graphics engines have limited update rate and polygon count.
6. The headgear is too heavy.
7. There are too many wires.
8. There is a need for a universal software architecture and tool kit for supporting future development and application of virtual worlds.
9. Virtual interfaces are too expensive.
10. There is no forum currently for discussing the development and applications of virtual worlds.

POSSIBLE SOLUTIONS

As research and development laboratories in universities and industry respond to the growing excitement about virtual worlds, we would propose that a research agenda be established to solve the problems above. Here are recommended approaches:

1. Establish a national knowledge base regarding the ergonomics, technology and application of virtual interfaces. Build a centralized literature collection, and interface with the Crew System Ergonomics Information Center (CSERIAC) at Wright-Patterson AFB, OH. Add to the Handbook of Perception and Human Performance and the Engineering Data Compendium published by the Air Force. Begin a scholarly journal to address issues of virtual interfaces including the psychophysics, technologies and applications of virtual worlds.

2. Explore new psychophysical and neurophysiological measurement techniques which operate within virtual worlds.

3. Develop high resolution parallel image projection approaches which reduce bandwidth and don't require the production of an aerial image.

4. Develop position measurement approaches which are passive.

5. Improve image stabilization (close loop outside graphics processor). Develop graphics processor to support parallel information input.

6. Eliminate wires with passive sensing and data links.

7 Create microscanner for Maxwellian view image projection.

8. Create mindware to take into account the perceptual organization of the human. Standardize on network protocols for televirtuality and transportability of software and applications.

9. Establish a special interest group on virtual interface technologies under the aegis of the ACM, IEEE or HFS.

CONCLUSIONS

Virtual interfaces provide a bold new opportunity for solving many of the perplexing problems of interfacing human and machine intelligences. As pioneers, we are obligated to pursue the development of virtual interface technologies in a systematic way and to leave a technology base and tools as our legacy for others to build upon. If developed systematically, virtual interfaces can be one of the greatest advances of our age.