VIRTUAL WORLD EDUCATIONAL APPLICATIONS

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We propose to develop configurable, interactive VR models to demonstrate and test applications for learning and for collaboration. This paper discusses the impact VR can have on both the form and content of education, and on the way people perceive and interact with information.

Education

VR interface technology couples human intention with increasingly powerful information systems. VR offers intuitive, experiential access to the potentially overwhelming complexity of fiber-optic telecommunications systems that will link individuals, groups, and vast amounts of information into the global matrix referred to as cyberspace. The multi-participant system we propose to develop links workstations using VR interface technology with fiber-optic telecommunications. This system can be extended to provide participants with synchronous 3-D multi-sensory access to virtual worlds.

VR's augmentation of behavior for amplified perception provides new modes of interaction in a diversity of fields, including education and collaborative work. However, education is not simply another application area for VR. The principles of learning, perception, and performance have shaped the design and evolution of this interface technology since its inception. The purpose of VR is to provide a more natural way for us to access and to understand complex information. It allows us to use the increasing power of technology in ways that are compatible with how we have learned to do things since infancy. Decreased learning time and increased performance are demonstrated advantages of this interface technology.

The unique aspects of the proposed educational application include new types of information acquisition and representation. We can see, hear and touch abstractions and extrapolations, partition concurrent virtual environments into social and private domains, and maintain ambiguity within and between virtual worlds. We can animate information using programmable entities, forces and dynamic contexts.

New types of behavior enable the VR educational environment to extend human capability, suggesting innovative activities. The sense of presence in an inclusive environment creates new freedoms and options: vocal and gestural commands allow interactivity at the pre-symbolic level; telepresence and teleoperation extend our range of activity; changing and sharing viewpoints extends our perception.

These new capabilities promise to make a remarkable impact on education (which is defined as the set of goals, methods, and materials of teaching). Our review of the technology's compatibility with successful educational techniques includes corroborative data from recent studies of group learning, computer-mediated collaboration, distance learning, educational simulation and technology curriculum pilot programs.

The impact of VR on learning (which is defined as the process involving individual perception, attention, cognition, memory, and performance) is foreseen to be highly significant, especially in the context of the Information Age. Not only is VR interface technology designed to be consistent with human factors studies in perception and performance, it is also highly configurable to individual learning needs and styles. New learning strategies and techniques are available.

VR capabilities are consistent with pedagogical precepts of learning theory and developmental psychology. Our design for educational VR is congruent with James, Piaget, Bruner, Papert, and others. We plan to explore the degree and nature of skills transfer from VR to the physical world.

In combination with wide-bandwidth connection to the information matrix, the VR environment empowers participants with comprehensive and comprehensible information access. Widespread participation in VR clearly invites evolutionary changes in the way we interact with each other and with information.

Learning and Training

Instructional Techniques

The characteristics of VR are the same as those of good teaching. The teacher wants to create an environment which is programmable (the curriculum) and which the students participate. The most important principle of classroom activity design is that the student's actions determine what will be learned. The contribution of VR is simple: everything we do to educate with words and with pictures can be provided as virtual experience. We can vary location, scale, density of information, interactivity and responsiveness, time, degree of participation.

Individualized Instruction: Programmable environments are personalized worlds. They are at the call of the participant, they can accommodate to prior actions or to specified preferences. VR provides a fully controllable, empirical context. Imagine that each VR entity stores its history, activities and interactions with the student. Imagine that each entity has access to statistical and classification algorithms. A teacher could ask for a synopsis of each students work in LogicLand; could toss tasks into a student's environment, each task calibrated to an appropriate skill level; could observe by inhabiting the task, by being the challenge.

Intelligent Training: Imagine assembling a carburetor composed of 15 intelligent virtual parts. As you try to put one piece into another, the piece could refuse, gently guiding your hand to the correct position. A part could squeak out if malhandled, could record the attempts to place it in a wrong position and offer diagnosis and immediate negative reinforcement.

Not all jobs become easy in VR, but programmable participation may well provide an idealized training environment. What-if scenarios, positive and negative reinforcement regimes, records of behavior and of common errors, weaknesses in the training sequences, lessons learned, in fact all aspects of training evaluation can be incorporated into virtual experience.

Natural Semantics

VR makes sense when what a participant sees and hears has a meaning that does not require explanation. Consider a house. A textual description requires reading skills, a procedural database (lists of coordinates) requires decoding, a picture can be recognized immediately but is not interactive. A house in VR is most like a physical house, you can look at it while walking around it, you can walk in the front door and explore each room. A physical house has natural semantics, no one needs to explain it.

Natural semantics is what a child learns before symbolic schooling. Most sciences have natural semantics, most symbolic studies (the three Rs) do not. Almost all symbolic studies are an attempt to refer to natural (visceral) semantics. We read in order to build a picture of the world, we write in order to describe our world to others.

The challenge to the design of VR training materials is to place learning in a natural (although virtual) context, to make learning as-if-real. Rather than teaching a structure of symbols (such as algebra) and then teaching the meaning of that structure, in VR we will first teach meaning through experience, then (if necessary) teach the symbolic abstraction of our experiences. Manuals and written descriptions can be integrated into the simulated display of objects. More fundamentally, written materials may be unnecessary, replaced by direct experience with virtual entities.

Validation

To demonstrate the value of training in VR, we must establish two types of validity. First, does experience in VR transfer to similar experience in physical reality? Second, does experience in VR transfer to later experience in other VR tasks?

The question of transfer of learning to physical environments requires assessment of the adequacy of modeling the physical task, of the training procedure itself, and of the learning of the trainee. In helicopter maintenance training, for example, the match between the virtual model and the physical equipment, the sequence of maintenance training steps, and the performance of the maintenance trainee will each have to be factored and evaluated.

There may be information tasks for which VR is a naturally more comfortable environment. For example, recording and tracking the flow of supplies through a corporation might be better presented and understood as a virtual simulation rather than as a large pile of physical documents. When dealing with information, the question of training may best be posed as transfer between separate tasks in VR, without regard to a physical circumstance. Here the modeling question is not focused on learning, it is focused on understanding of existing information (visualization).