Distributed Immersive Virtual Reality Simulation Development for Medical Education

Dale C. Alverson, M.D.[1], Stanley M. Saiki Jr, M.D.[4, 8], Thomas P. Caudell, Ph.D.[2], Kenneth Summers, Ph.D.[2], Panaiotis, Ph.D.[2], Andrei Sherstyuk, Ph.D.[4], David Nickles, M.S.[4], James Holten, III[2], Timothy E. Goldsmith, Ph.D.[3], Susan M. Stevens, M.S.[3], Kathleen Kihmm[4], Stewart Mennin, Ph.D.[1], Summers Kalishman, Ph.D.[1], Jan Mines, M.A.[1], Lisa Serna[1], Steven Mitchell, M.D.[1], Marlene Lindberg Ph.D.[4], Joshua Jacobs, M.D.[4], Curtis Nakatsu, M.D.[4], Scott Lozanoff, Ph.D.[4], Diane S. Wax, M.P.A., M.B.A.[1], Linda Saland, Ph.D.[1], Jeffrey Norenberg, PharmD.[5], George Shuster, DNSc.[6], Marcus Keep, M.D.[1], Rex Baker, M.D.[1], Holly S. Buchanan, Ed.D.[1], Randall Stewart, M.D.[1], Mark Bowyer, M.D.[7], Alan Liu, Ph.D.[7], Gilbert Muniz, Ph.D.[7], Robert Coulter, M.A.,[1] Christina Maris[1], David Wilks, M.D.[1]

[1]School of Medicine, [2]School of Engineering, [3]Department of Psychology, [5]College of Pharmacy, and [6]College of Nursing

[1]University of New Mexico, Albuquerque, New Mexico 87131 U.S.A.

[4]John A. Burns School of Medicine University of Hawaii, Honolulu, Hawaii 96822 U.S.A.

[7]National Capital Area Simulation Center, Uniformed Services University of the Health Sciences, Silver Springs, Maryland 20910 U.S.A.

[8]Pacific Telehealth and Technology Hui, Tripler Army Medical Center, Honolulu, Hawaii 96859 U.S.A.

Phone: (+)1-505-272-8633 Fax: (+)1-505-272-0800 Email: dalverson@salud.unm.edu

ABSTRACT

Training professionals for real-world application of required knowledge and skills and assessing their competence are major challenges. Simulations are being used in education and training to enhance understanding, improve performance, and assess competence. Validated virtual reality (VR) simulations provide a means of making experiential learning reproducible and reusable. Advanced communication networks, such as Internet2 Access Grid, allow dissemination of these simulations and collaborative learning independent of distance. The prior experiences of our three universities led to an interdisciplinary collaboration to further develop and evaluate an integrated, fully immersive, interactive VR based system. This environment employs simulations that are visually three-dimensional and are driven dynamically by a rules-based artificial intelligence engine within Flatland, a virtual environments development software tool, and associated commodity hardware. Studies include usability and validation, deployment for distributed testing over Internet2, and evaluation of impact on training and performance using concept mapping and knowledge structure methods. Subject matter experts found face and content validity in our closed head injury simulation. Seven pairs of medical students participated collaboratively in problem solving and managing of the simulated patient in VR. Students stated that opportunities to make mistakes and repeat actions in VR were extremely helpful in learning specific principles and they felt more engaged than in standard text-based scenarios. 48 students participated in knowledge structure experiments pre and post simulation experiences. Knowledge structure relatedness ratings were significantly improved in those students with lower pre-VR relatedness ratings indicating a potential value of VR simulation in learning. This research cuts across the integration of computing, networking, human-computer interfaces, learning, and knowledge acquisition. VR creates a safe environment to make mistakes and could allow rapid deployment for just-in-time training or performance assessment.