USC IMSC

A NATIONAL SCIENCE FOUNDATION
ENGINEERING RESEARCH CENTER

Virtual Environments for Human Performance Testing and Training

User Centered Sciences

Yeh Shih-Ching, Jane Hwang, Baharak Zali, Gerry Kim, Cyrus Shahabi & Skip Rizzo

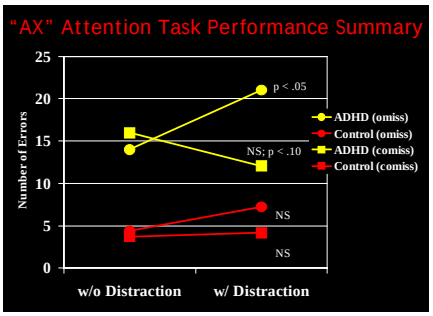
Research Goal

The primary goal of this project is to design, develop, implement and evaluate psychometrically reliable and valid Integrated Media System (IMS) testing and training environments that target human cognitive and behavioral processes in normal and impaired populations. A key element of this goal, is the advancement and integration of the computer and engineering science needed for creating IMS applications that have maximal access across the widest possible range of users. The continued evolution of this research area can be seen in the projects described below.

Role in IMSC

The design, development and evaluation of advanced integrated media systems (IMS) with attention to their usability and usefulness by humans is at the core of the IMSC mission. These projects have driven research on the underlying enabling technologies required to support efficient and effective system development that will also serve to advance the knowledge base available to other scientists addressing IMS development, implementation and evaluation. Enabling technology advancements in the areas of graphic rendering, avatar creation and immersidata capture and analysis have supported this effort. Future integration of IMSC advances in computer vision based tracking, haptics and immersive audio are expected to advance the usability and usefulness of the "next generation" of these systems.

The Virtual Classroom Project



The Virtual Classroom HMD system was designed to assess cognitive attention performance in normal children and children with Attention Deficit Hyperactivity Disorder (ADHD) using a virtual classroom. This environment consists of a classroom scenario that allows for ecologically valid diagnostic assessment of attention to target stimuli and motor reactivity while in the presence of systematically delivered distractions. Based on successful trials conducted at IMSC that demonstrated the validity of this form of assessment, the scenario was evolved into a commercial application in partnership with The Psychological Corporation and Digital MediaWorks and is now undergoing standardization trials at six international research centers. As well, the scenario has been reconfigured for use by a varied group of international collaborators for testing and training of eye-scanning, complex attention, social anxiety disorder in children and earthquake safety training with children with developmental disabilities.

Flexible reconfiguration of this "Archetypic" scenario for other purposes:

Eye tracking and head movement using the Elumens Dome Display format (St. Anslem's College)

Public speaking with children who have Social Phobia (Virginia Tech)

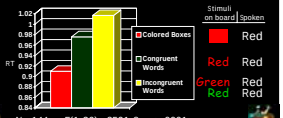
Flexible reconfiguration of this "Archetypic" scenario for other purposes:

Virtual Earthquake safety training tool for children with developmental and learning disabilities. (Aristotle University of Thessalonica, Greece)

VR Classroom Stroop Test

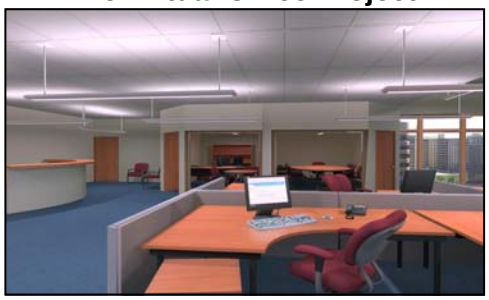
Rizzo, Kerns & Mateer

VR Classroom Stroop Test



*No Difference when using traditional error counts!

The Virtual Office Project



The success of the Virtual Classroom development cycle has served as a model for our development work resulting in the creation of a virtual office environment as an open platform for assessment and rehabilitation of cognitive and vocational performance in adults. In collaboration with the Kessler Medical Rehabilitation Research Center (New Jersey) and the University of Haifa (Israel), we have conducted research with normal and traumatic brain injured (TBI) subjects on object memory and user interaction in this environment across both HMD and projection screen platforms. The HMD scenario produced results with the TBI population that extended beyond what is possible with traditional paper and pencil memory assessment instruments suggesting area of preserved functioning. Also, poor user memory performance and low preference was found with normals using the Virtual Office in the non-HMD mode. The environment is now being programmed to conduct testing and training trials for attention and executive functioning based on our initial findings using the HMD.

The Virtual Visuospatial Project

Our previous work in this area produced impressive training results using projection-based display technology to conduct a series of research trials with ImmersaDesk-delivered scenarios that targeted the testing and training of visuospatial processes including visual field-specific reaction time, depth perception, 3D field dependency (virtual rod and frame test), static and dynamic manual target tracking in 3D space, and spatial rotation. We have now developed a similar set of applications that are PC-deliverable and can present stimuli on multiple display formats (PC Monitors with shutter glasses, projection systems and stereo head mounted displays (HMD). The current PC system expands access to these applications to a wider range of investigators interested in studying these cognitive variable across a range of normal and clinical populations (brain-injury, stroke, learning disability, dementia) under varied perceptual (mono vs. stereo)/interactional (active vs. observational) conditions. We are also working with two groups of researchers using our system to examine the influence of spatial ability on transfer of training from surgical simulations (University of Central Florida; Karolinska Institutet, Stockholm).

Visuospatial Testing and Training/3D User Interface Benchmarking Environment

- A series of Visuospatial testing and training scenarios deliverable in both Mono/Stereo and Active/Passive modes.
- System allows for object selection and manipulation interface devices and interactional methods to be compared with normative data from standardized user trials.
- Pre-existing visuospatial ability can be statistically parceled out of speed and efficiency performance metrics by use of the highly reliable/valid Mental Rotations Test.