The John-e-Box: Fostering Innovation, Inclusion, and Collaboration through Accessible Advanced Visualization

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ABSTRACT
Recent advances in commodity graphics and projection hardware have motivated many notable research projects and community discussions about the potential of these technologies to make advanced visualization more broadly accessible. However, the actual realization of this promise on a significant scale is challenging, requiring strong institutional commitment, expert technical support, and a broader visualization context. This paper describes an ongoing effort at Indiana University (IU) to develop a commodity-based, large-format, 3D stereo display system and to deploy a collection of such systems to a range of classrooms, laboratories, galleries, and learning environments throughout the IU system and the State of Indiana. To date, these systems have been used in over 30 projects by investigators in 15 departments across four different IU campuses. In addition, this technology has been used to reach well over 3,000 individuals through a series of coordinated outreach efforts. This initiative is also notable for fostering new interpersonal collaborations and inter-departmental cooperation, for enabling non-traditional applications in education and artistic expression, and for providing an interface to other advanced information technology efforts.

Categories and Subject Descriptors
I.3.7 [Three-Dimensional Graphics and Realism]: Virtual reality; J.2 [Physical Sciences and Engineering]: Astronomy; J.5 [Arts and Humanities]: Fine Arts; K.3.1 [Computer Uses in Education]: Collaborative Learning

General Terms
Design, Economics, Human Factors, Reliability

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Keywords
stereoscopic display, virtual reality, visualization

1. MOTIVATION
Over the past two decades, high-end visualization and virtual reality technologies have had broad and significant impacts on Indiana University's missions in research, education, and creative activity. These large-format, interactive, 3D stereo display systems (which have included a CAVE™ and an ImmersaDesk™ [1] driven by high-end SGI graphics workstations) are crucial for fully engaging users' natural sensory capabilities, for communicating complex spatial relationships, and for providing a sense of scale and environmental presence. These technologies have been instrumental in helping scientists to analyze complex data sets and collaborate with colleagues; in helping students to experience historical spaces and understand important scientific phenomena; and in helping artists and designers communicate their innovative concepts and creative experiences. Unfortunately, these systems suffer from several important accessibility restrictions that stem from being scarce, shared, campus-wide resources that are driven by proprietary compute systems that are not widely available.

Over the past three years, the Advanced Visualization Lab (AVL) [2], a part of University Information Technology Services (UITS) at IU, has been working to harness the technological advances that have revolutionized the gaming, entertainment, and home theater industries to enable the delivery of advanced visualization capabilities to a broader audience across the University and the State of Indiana. One major and innovative result of this effort is the "John-e-Box" – a portable, large-format, 3D stereo display system. (See Figure 1.) The John-e-Box is a key component of the University's plan to deliver advanced visualization capabilities directly into the labs, classrooms, and studios of the University's researchers, educators, and artists. It has been licensed to and commercialized by Indianapolis-based CAE-net, Inc.[3], and an initial deployment of eleven systems is underway on the IU Bloomington, IUPUI, IU Northwest, and IU East campuses.

The major objectives of this large-scale John-e-Box deployment are: (1) to improve the overall utilization of high-end visualization by making these systems widely available; (2) to extend high-end visualization capabilities to new users, especially at IU's regional campuses; (3) to promote innovation and inter-departmental collaboration by standardizing the technology; (4) to provide systems that can be easily transported to allow users to bring the display to any audience; and (5) to create a technological bridge to the University's highest-end visualization systems such as the CAVE, as well as to advanced networking, storage, and supercomputing resources.

2. TECHNOLOGY AND RELATED WORK

The John-e-Box uses technology similar to other large-format, passive stereo display systems offered commercially by companies such as VisBox [4] and VizEverywhere [5], or promoted in open consortiums for individually-built configurations such the GeoWall [6] and AGAVE [7] projects. All of these systems are made possible by the convergence of four key technologies: bright, inexpensive, DLP projectors, polarizing filters and polarization-preserving screens, desktop computers with powerful 3D graphics hardware, and capable and flexible open-source software. Technologically, the John-e-Box goes beyond the other commercial systems by providing a simple, compact, and highly portable enclosure. Moreover, the cost is considerably lower than the other commercial devices since the primary focus is on successful utilization, rather than commercial profits. As a deployment project, IU's John-e-Box efforts differ from the other open consortiums because of the size of the deployment within a given institution and region, the diversity of applications represented by that deployment, and uniformity of the systems (which allows for greater specificity in support and documentation and also facilitates easier sharing of content and applications.)

3. DEPLOYMENTS AND APPLICATIONS

Presently, eleven John-e-Box systems have been deployed to a diverse group of departments and users across four campuses of the IU system. These departments were selected based on project involvement, demonstrated needs, and local system support capabilities. The collection represents the breadth of research, education, and creative activities across the IU system. These deployments and typical users and applications are summarized in Table 1.

In addition to the IU deployments, a John-e-Box system has been purchased by the Indianapolis Museum of Art for installation in its new technologies gallery. This system will display custom interactive 3D art pieces inspired by the museum's traditional collections. The Ruth Lilly Health Education Center in Indianapolis is also evaluating the system for displaying stereoscopic teaching animations on a variety of health-related topics.

The communicative power of the John-e-Box, along with its simple portability, have played a crucial role in fostering effective and sustainable community outreach and external relations efforts that have reached well over 3,000 individuals over the past two years. Outreach for students in grades 3-12 has come through work with regional libraries (Indianapolis-Marion County Public Library) and learning centers (Brownsburg Challenger Center), as well as the University's community campus days ("Explore

Table 1. Current John-e-Box Deployments at Indiana University

Department	User base*	Typical Applications
Indiana University Bloomington		
Chemistry	F, S, G, U	Molecular visualization, crystallographic structure analysis
Informatics	F, S, G, U	Collaborative model sharing, educational content development
Fine Arts	F, G, U	Interactive, immersive art works
Advanced Vis. Lab	F, S, G, U	HPC visualization; Community outreach
Geology	F, G	Seismic tomography visualization
Indiana University – Purdue University Indianapolis		
Computer Science	F, G, U	Scientific visualization; 3D game programming
New Media (2 units)	F, S, G, U	Education & health informatics; Cultural heritage environments
Advanced Vis Lab	F, S, G, U	Engineering visualization; GIS analysis; Community outreach
Indiana University Northwest (Gary, IN)		
Information Tech	F, S, U	Molecular visualization; general 3D programming
Indiana University East (Richmond, IN)		
Information Tech	F, S, U	Artistic and sculptural environments; Molecular visualization

***** Faculty, Staff, Graduate, Undergraduate

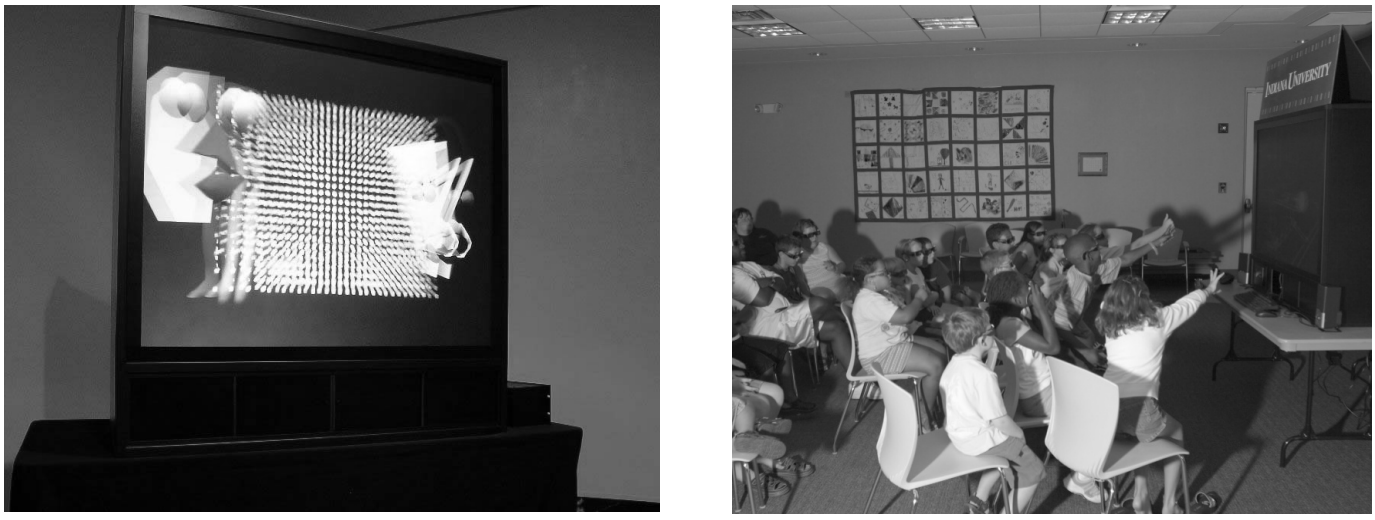
IUPUI"). Outreach to the broader University community has come through departmental talks and demonstrations, along with participation in University-sponsored information technology awareness events such as "Making IT Happen", which takes place annually on all eight IU campuses, and "Linuxfest", which promotes applications of Linux and open-source technologies. External relations to other research communities has come through demonstrations at local, regional, and national conferences, including the IU-Purdue I-Light Conference, the Indiana Statewide GIS Conference, and the IEEE Supercomputing Conference. Communication with local and regional commercial groups has been facilitated through many conferences and forums oriented towards information technology and the life sciences.

4. NOTABLE COLLABORATIONS

Perhaps the greatest indicators of the John-e-Box project's success are the new collaborations that it has fostered within the University and the community. The following are two of the many examples of synergies created through the broad, standardized deployment of these systems.

- ***Fine Arts and Indianapolis Museum of Art*** – Professor Margaret Dolinsky of the H.R. Hope School of Fine Arts at IUB is widely recognized for her innovative and expressive CAVE-based art pieces. Long hampered by the inability to show her work in traditional galleries and museums (because CAVEs are not transportable), she became an early adopter of the John-e-Box and was helpful in verifying the technology for extended use in galleries. (See Figure 1a.) When the Indianapolis Museum of Art was seeking ideas for their new experimental technology gallery, the convergence of Dolinsky's artistic talent, the John-e-Box technology, and AVL support made the installation a reality.

- ***Astronomy Education and Outreach*** – The landing of the Mars rovers in early 2004 created a renewed public interest in astronomy and space sciences. The IU School of Informatics hosted a day-long event called "iMars" to educate the University community and the general public about relevant research going on worldwide and at IU. The AVL worked with the School to develop a five-minute stereoscopic movie based on stereo images sent back from the rovers. Subsequently, the AVL was approached by the Indianapolis – Marion County Public Library to support the Library's participation in the "NASA In Your Library" program. The AVL extended the iMars content and adapted several other existing astronomy visualizations to participate in this multi-day program that reached over 400 school-aged children and their parents. (See Figure 1b.) This, in turn, garnered the attention of the Brownsburg Challenger Center and has led to an ongoing collaboration between the AVL and the Center based on astronomy and space sciences applications.



(a) **(b)**

Figure 1. (a) John-e-Box system displaying an interactive art piece at the IU Fine Arts Gallery; (b) at a branch of the Indianapolis-Marion County Library for the "NASA In Your Library" program.

5. DISCUSSION

Many factors contribute to the success of a large-scale, new technology deployment like the John-e-Box project, but we believe that it all begins with strong institutional support. This support includes not only the financial resources for research and development and system acquisition, but also the expert personnel to provide dedicated technical support, user training, and content development. It is also important to identify a diverse group of users who are open to sharing their ideas, methods, and content. We are seeing the confluence of good technology, innovative ideas, and strong support leading to a wealth of interesting applications and successful collaborations. The end results of these efforts are the meaningful utilization of advanced visualization by a growing community within the University, and the exposure of substantial audience outside the University to the capabilities and possibilities of advanced visualization and information technology.

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