Real-time visual simulation models in an exhibition environment

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Real-time visual simulation offers a compelling installation alternative to immersive virtual reality systems for the exploration and analysis of large-scale urban environments in an exhibition setting. The following discussion describes two installations involving Urban Simulation Team models and recounts some of the decisions that shaped the use of the technology, with a focus on exhibition purpose and attendance projections (including its impact on exhibit design). Development and hardware costs, and long-term maintenance will also be mentioned, but only as secondary considerations.

Exhibition purpose

In his survey on *Exhibition in Museums* (1993, 142), Michael Belcher makes the point that the legitimate and necessary role of media in a museum is to "support, amplify and interpret the objects" in the installation. He goes on to question that moment when the media overtakes the object and becomes entertainment for its own sake. Though only published in 1993, Belcher does not specifically comment on virtual reality, but his position has resonance for our discussion – technology is best incorporated into an installation when its strengths can support the purpose of the exhibit and offer a level of interpretation superior to that possible with any other medium.

Attendance projections

A critical challenge for immersive forms of virtual reality, particularly for the major museums, is to provide a satisfactory experience for a large percentage of anticipated visitors without disrupting the overall pace through the installation. There is a vast difference between accommodating the 6,863 visitors a day who toured the blockbuster Leonardo da Vinci, master draftsman show at the Metropolitan Museum of Art and the

The Urban Simulation Team at UCLA is a research group exploring applications for real-time visual simulation in design, urban planning, emergency response, and education. The Team's signature project is Virtual L.A. From top to bottom: a general view of the downtown area in Virtual L.A., the Music Center complex, the Bradbury Building.

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931 visitors a day at the Mercati di Traiano installation on the colored marbles of Imperial Rome (statistics from The Art Newspaper's 2003 survey of international exhibition attendance figures). And it is this challenge that virtual reality proponents must understand and address in order to encourage wide spread use of the technology in public institutions.

Trajan's Forum at the J. Paul Getty Museum

"Beyond Beauty: Antiquities as Evidence" was the major opening exhibition at the J. Paul Getty Museum in Brentwood. (The museum and exhibit opened in December 1997; the exhibit was on view until January 1999). This exhibition explored the historical, cultural, and technological information contained within ancient works of art and included looped footage from a real-time reconstruction model commissioned by the J. Paul Getty Trust of the Forum of Trajan, the largest of the Imperial Fora in the Forum Romanum.

Exhibition purpose

Curator of Antiquities Marion True and then-Associate Curator of Antiquities John Papadapoulos coordinated the involvement of the Urban Simulation Team as one aspect of the exhibit's theme – modern use of the information contained in ancient art. The project was also a logical companion to the release of the monumental three-volume publication of Northwestern University Classics Professor James Packer's *The Forum of Trajan in Rome: A Study of the Monuments* (Berkeley: UC Press, 1997). Construction of the model followed Packer's reconstruction and he was consulted to resolve areas of uncertainty and ambiguity revealed by the modeling process.

Attendance projections and exhibit design

The Getty opening was a major cultural event in Los Angeles. In its first four months, attendance wildly exceeded early projections and in 1997, its first full year of operation, the museum had 1.8 million visitors. Since then, their average attendance has leveled at about 1.5 million visitors per year.

Accommodation of the anticipated visitor load played a key role in the final exhibit design and the use of the simulation model. Early discussion focused on creating some type of interactive display that would allow visitors to manipulate the model. However, concerns about staffing, visitor flow, hard-

Screen snapshots from the Trajan's Forum model. From top to bottom: the plaza, the primary entry to the Basilica Ulpia, an interior view of the Basilica Ulpia, and one of the libraries.

ware, and maintenance quickly shifted the installation concept to a fixed presentation that could be more easily controlled. Ultimately, a multimedia production company was hired and director Andy Behar created two video elements that were played on a loop and projected continuously. The loop alternated between a Learning Channel-type sequence that featured the project participants commenting on the benefit and importance of virtual reconstructions and a sequence of edited model footage backed by classical music.

In the final exhibit design, visitors freely moved through a sequence of exhibit spaces with the Trajan element as a semi-enclosed room in the final third of the roughly linear path (in part to isolate the sound of the presentation and also to allow control of the light levels). Archaeological drawings and two-dimensional reconstruction views lined the approach corridor. Within the semi-enclosed room a cluster of large-scale objects from the Forum were displayed on either side of the projection screen. A single bench was provided for visitors who wanted to stay for the entire video sequence (approximately six minutes long).

Summary

This arrangement maximized the number of visitors who could experience the real-time reconstruction while also addressing the purpose of the overall exhibit. The looped video sequence also minimized maintenance concerns and kept hardware requirements to manageable levels. Unfortunately, the installation negated one of the key benefits of real-time simulation – the ability to interact at will with the modeled environment.

The Getty still maintains a website that features the Forum project as a part of their ArtsEdNet network (www.getty.edu/artsednet/Exhibitions/Trajan/index.html)

Artifacts displayed with the Trajan's Forum model in the Getty installation.

The Herodian Temple at the Davidson Center for Exhibition and Virtual Reconstruction

The Urban Simulation Team's real-time reconstruction model of the Herodian Temple Mount was commissioned by the Israel Antiquities Authority and is currently installed at the Davidson Center for Exhibition and Virtual Reconstruction in Jerusalem. At the Davidson Center, the development and construction of the model and the facility were concurrent, with the final form of

The Davidson Center is nestled in four storerooms from an Umayyad Palace in the IAA excavations immediately adjacent to the Temple Mount.

the installation shifting to highlight the technology much more than was originally planned. There is no doubt that the model has contributed significantly to the success of the Center. It has proven to be an ideal vehicle for sharing the scholarly information with both the general public and other researchers, and the flexibility afforded by the technology allows the archaeologists to tailor presentations to diverse groups of visitors.

Exhibition purpose

In 1994, the Israel Antiquities Authority, the Israeli Ministry of Tourism, and the Jerusalem Municipality initiated the creation of the Jerusalem Archaeological Park, an umbrella designation for the cluster of important archaeological sites adjacent to the Temple Mount. The Park includes the Ophel Gardens, the City of David, the western slopes of the Mount of Olives, the Kidron Valley, the east slope of Mount Zion, and the Valley of Hinnom. Following the 1994-1996 excavations adjacent to the Temple directed by Ronny Reich, IAA management and archaeologists began investigating the possibility of establishing a visitor's educational center within the Park's boundaries – a vision that ultimately resulted in the construction of the Davidson Center.

The Center's main mission is to provide visitors with information about the archaeological remains and the history of the area and to educate the public about the archaeological work of the IAA. The focus is on the remains dating to the Second Temple period, highlighting the Herodian Temple Mount and the excavations along the southern wall and the southern part of the western wall. Other time periods – First Temple, Roman, Byzantine, Crusader, and Umayyad – are presented on a smaller scale.

This focus on a specific site at a specific point in time created a perfect setting for a computer reconstruction model.

Audience projections and exhibit design

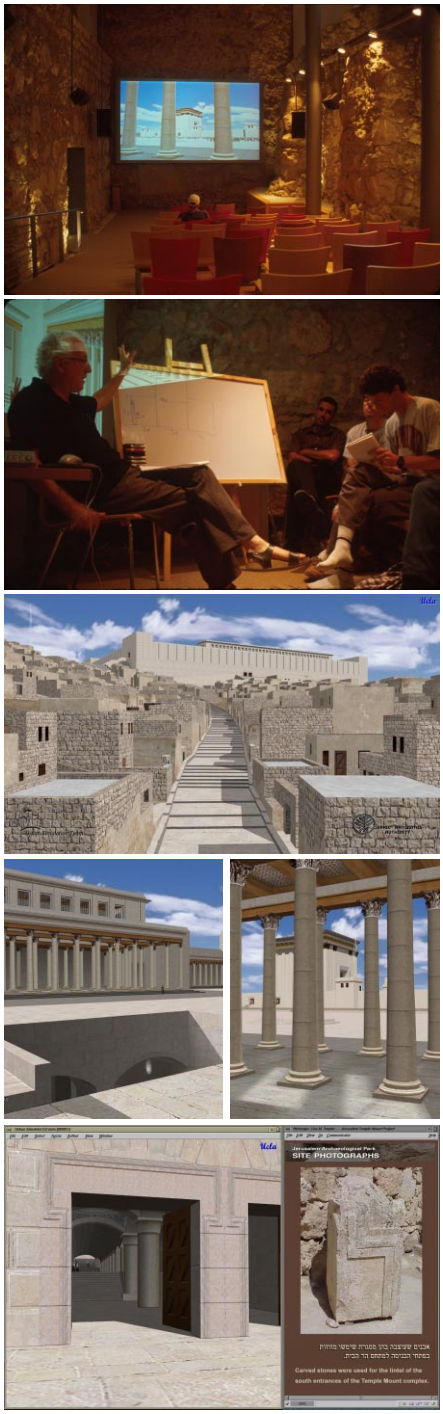
Early projections estimated that somewhere between 1 and 1.5 million people passed by the main entrance to the Park annually because of its proximity to the Western Wall, the Western Wall tunnels, and the major tourist attractions of the Old City of Jerusalem. The Davidson Center could only expect a small portion of those visitors, in part because of competition from free archaeological and religious sites and established cultural institutions.

The Davidson Center. From top to bottom: view towards the Temple Mount with the Center in the foreground, the main entry, a class beginning a tour of the facility, one of the exhibit rooms.

The Center itself is nestled in the remains of four underground storerooms from an Umayyad-period palace across from the southwestern corner of the Temple Mount and near a gate in the city wall. The shape of these rectangular rooms – each approximately 17 x 66 feet – suggested a linear visitor flow that would culminate in a tour of the excavations. Indeed, visitors today tour through exhibit rooms describing the history of the Temple Mount complex, then have the opportunity to take a virtual tour of the reconstruction model with an archaeologist guide in the center's interactive classroom before exploring the adjacent IAA excavations. Digital photographs of fragments that informed Ronny Reich's reconstruction are embedded within the virtual environment to provide a link between the actual excavation work and the reconstruction. The archaeologist guides can retrieve any or all of these images and discuss them as they see fit during their tours. Exit interviews have determined that these images are very important to the visitors' understanding of the excavations and the archaeological process.

The use of the storerooms as a footprint for the Center also limited the options for the simulation installation. Jacob Fisch, executive director the Friends of the Israel Antiquities Authority, discussed this challenge in a paper presented at the 16th International Congress of Classical Archaeology:

> The delivery system for the VR model presented the planners with serious challenges. The goal was to give the audience that special virtual reality immersive experience and the ability to fully interact with the real-time environment. Rather than limiting the viewing experience to a 5-10 minute video presentation of a reconstruction similar to those done at Getty and the British Museum, it was imperative that the Davidson Center installation be flexible so that presentations could be tailored to diverse audiences. Alternatives ranging from goggles, booms, the cube, various helmets and other headgear, were seriously investigated and priced. The system finally chosen for the presentation of the VR model in the Davidson Center was a an SGI single pipe 64 bit dual processor Infinite Reality 3 Onyx2 computer, connected to a high resolution DLP Barco projector. Space and budget considerations prevented the installation of a recommended three pipe Onyx with



The Davidson Center. From top to bottom: the main auditorium, archaeologist Ronny Reich in the interactive classroom, screen snapshots from the reconstruction model (general view, the Royal Stoa, the Second Temple), annotated image as visitors would see it during a virtual tour.

three projectors that would have provided a marked resolution difference and possibly somewhat smoother manipulation of the model. The possibility of constructing a 20-25 seat reality center with a curved screen was also discussed with SGI officials, but due to space limitations and cost consideration, a decision was made to present the VR model on a flat screen of roughly 3 X 2 meters in a classroom accommodating up to 35 people.

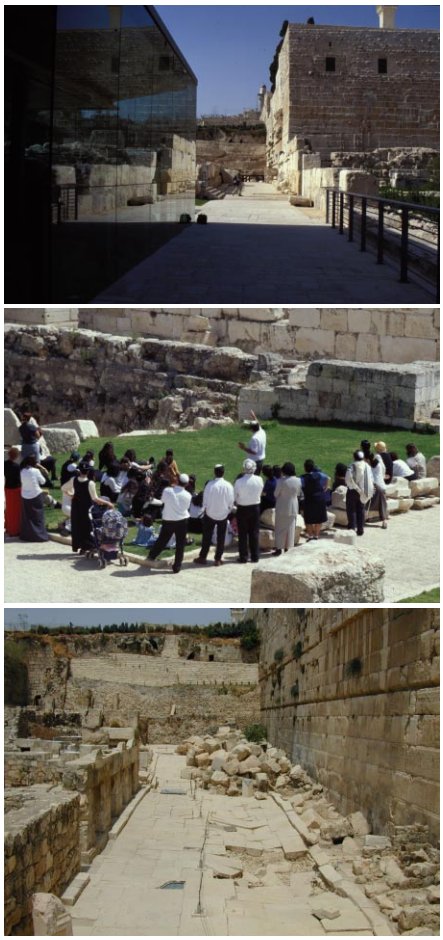
In addition to the live VR model session, and to compensate for the lack of a 'wow' effect associated with a large screen, visitors to the Davidson Center are shown a high-definition movie – *Pilgrimage to the Temple Mount* – projected on a 21 foot long screen that combines footage from the VR model with footage of live actors shot on and around the IAA excavations at the base of the Temple Mount.

The Davidson Center opened in April 2001 and became almost overnight one of the main destinations for visitors to Jerusalem. Even though the Intifada has devastated tourism in Israel, in its first full year of operation the Davidson Center hosted nearly 55,000 visitors (between 200 and 250 per day).

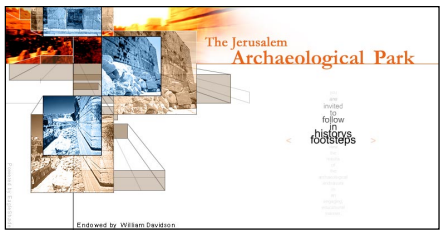
Summary

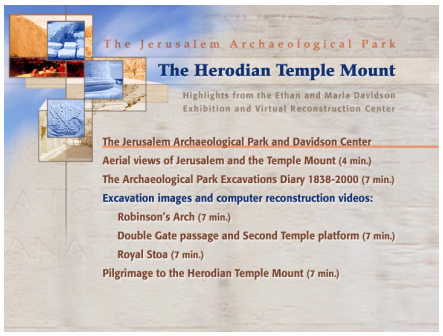
The focus of the Davidson Center coupled with its relatively small attendance figures (when compared with major institutions) created the ideal environment for an interactive real-time installation. Visitors are given the opportunity to explore the reconstruction model with an archaeologist guide, albeit for a limited amount of time. This allows the Center to manage visitor flow and establishes a format for group visits (e.g. tourists or school classes). The simulation can also be shown in the main auditorium for larger groups or in the event of increased tourism.

The Jerusalem Archaeological Park website (www.archpark.org.il) actively disseminates information related to the IAA excavations and the history of Jerusalem including a discussion of the creation of the reconstruction model. A DVD was also produced of highlights from the Davidson Center that includes over 20 minutes of annotated footage of a flight session with the reconstruction model.



The Davidson Center. Following the virtual tour, visitors are free to explore the excavation area.





The opening page of the Jerusalem Archaeological Park website and the main page of the Davidson Center DVD.