

The NAVE Design and Implementation of a Non-Expensive Immersive Virtual Environment

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As demonstrated by the popularity of the CAVE and products such as the Virtual Workbench, there is a great amount of interest in projected stereoscopic environments as alternatives to head-mounted displays. One of the primary obstacles to their widespread adoption has been their high cost.

The goal of the NAVE project was to design a low-cost, PC-driven, multi-screen, multi-user, stereoscopic, virtual environment with many of the desirable elements of the CAVE at a fraction of its cost. The NAVE was built at a total price of less than \$60,000.

The NAVE is a three-screen environment. Each screen measures eight feet (2.4m) wide and six feet (1.8m) high. The screens are positioned at 120-degree angles to each other, producing a three-sided display area sixteen feet (4.8m) wide and approximately seven feet (2.1m) deep. The user is in a seat positioned at the center of the semi-circle formed by the three screens. Imagery for each screen is generated on a 500MHz Pentium III PC and back-projected in stereo by means of polarized light. To experience the stereoscopic effects, the user wears inexpensive, lightweight polarized glasses. A fourth PC coordinates the three screen-rendering machines and provides directional sound for the NAVE.

In the tradition of the CAVE, the name NAVE is a recursive acronym (NAVE Automatic Virtual Environment). The name is also an acronym for its design goals: a non-expensive automatic virtual environment. Finally, the name has an architectural context. A nave is the central part of a cruciform church building, appropriate for our first application,

the Santiago 2000 Virtual City. The Spanish city, Santiago de Compostela, has since the early Middle Ages been one of the most important pilgrimage sites in the Christian world. It is said to house the remains of the Apostle Saint James, brought from Palestine after his death in 42 AD. Santiago de Compostela was chosen as one of nine cultural capitals for the European Union in the year 2000. To celebrate this event, along with the general euphoria of the new millennium, the Santiago 2000 Project was commissioned to build a computer-generated virtual environment to recreate the area surrounding the city's historic cathedral.

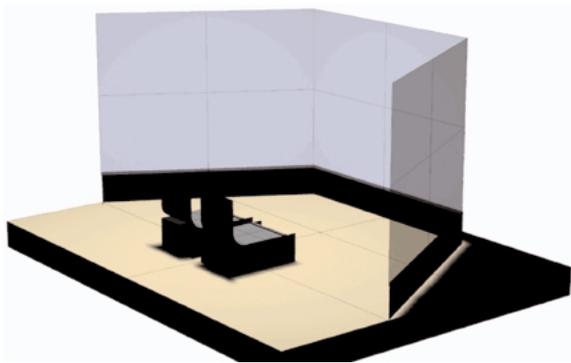
The NAVE and the Santiago 2000 project was a collaborative effort between the Virtual Environments group of the Georgia Institute of Technology and the Technological Research Institute of the University of Santiago de Compostela, Spain.

PROJECTORS, MIRRORS, AND SCREENS

We utilized VREX 2210 stereoscopic projectors, which use a linear polarization scheme and provide a mono resolution of 1024 x 768. Using mirrors, we employed a folded-optics system to achieve the necessary projector-throw distances.

CONCLUSION

The NAVE succeeds in making many of the advantages of the CAVE available at a significantly lower price. Chief among these is the high degree of immersion of a large-screen environment with a large field of view. In addition, the NAVE's extensive audio features serve to heighten this sense of immersion.



NAVE screen configuration.



Screenshot of the Santiago 2000 virtual city, the first NAVE application.