

Overview

An interactive environment where facility layout designers may develop and test their existing ideas and design skills towards creating more efficient manufacturing and storage facilities.

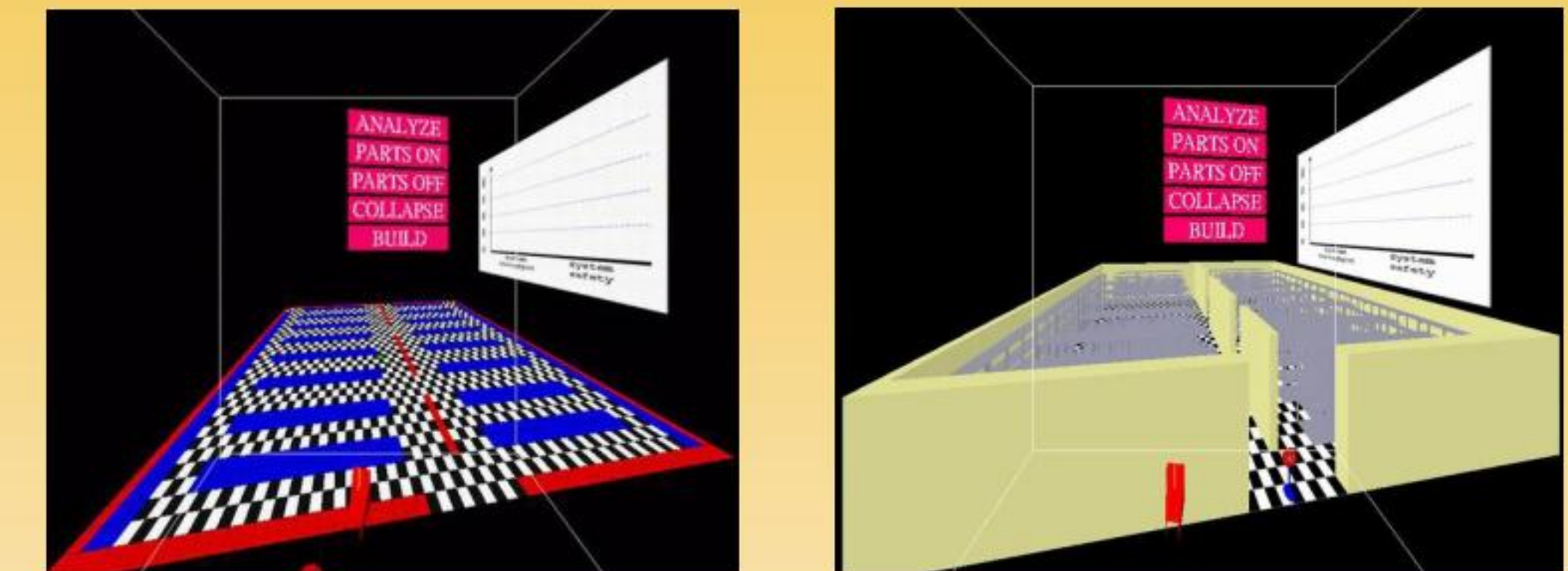
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Utilities and Methods Developed

- Interactive floor plan development utility with extrusion capabilities for construction of the warehouse
- Optimal storage assignment and retrieval of items
- Analysis and display of simulation results
- Utility for picking up storage items for a detailed visual inspection
- A systematic mapping of software generated from the SGI workstation to the CAVE
- Performance optimization strategies in order to render a very large database of 3D objects with an acceptable frame rate

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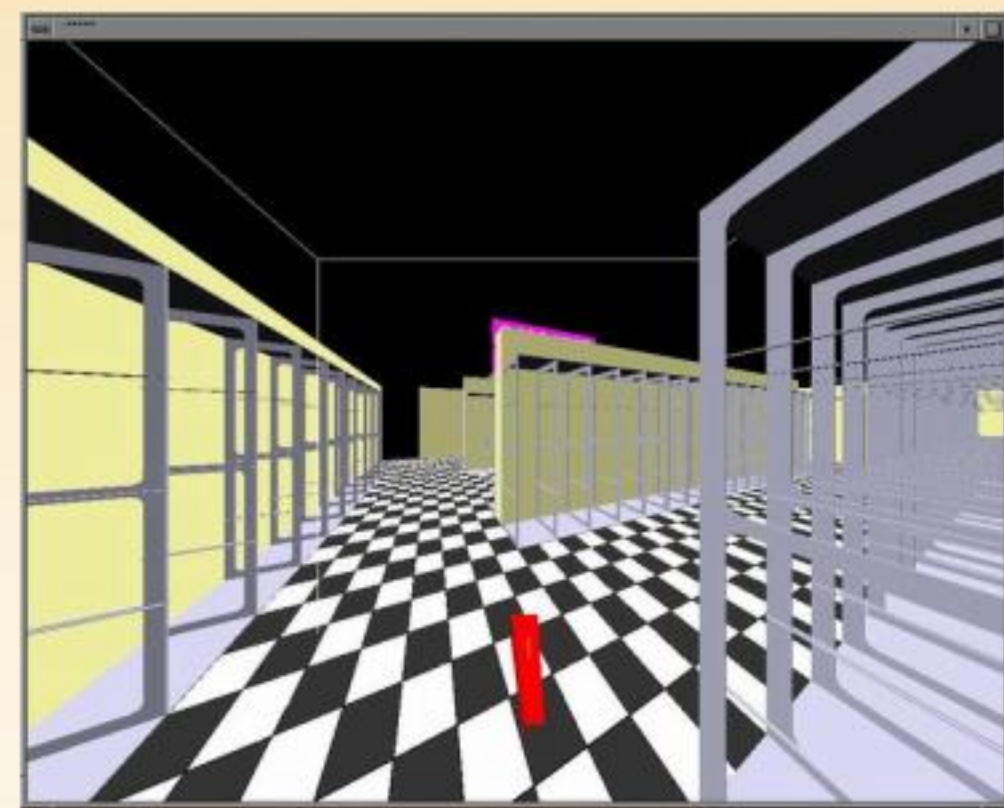
Interactive Floor Plan



Floor plan can be created from scratch and extruded into a 3D model

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Walk-around in Virtual Warehouse



The CAVE user/users can walk around inside the storage facility or even fly over it, exploring a structure that doesn't even exist yet. After viewing from various standpoints and angles, the existing design may be modified. Significantly lower construction cost and time can be achieved.

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Optimal Storage Assignment



The CAD/PAD products are optimally placed on the storage racks using the "Dedicated Storage" algorithm in order to obtain a higher system throughput performance.

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Storage Performance Analysis

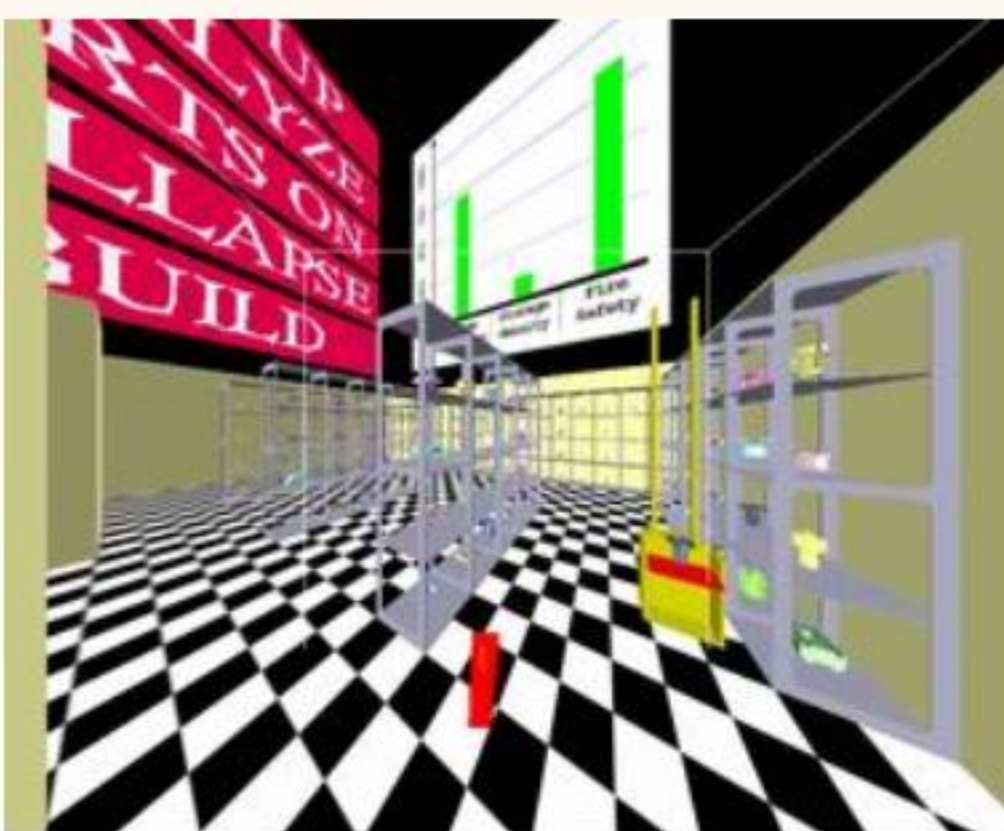
Embedded "Analysis Module" within our "Virtual Warehouse" program analyzes the system with respect to three different system performance criterion:

- Storage density
- System throughput
- Explosion/fire safety

The results of this process are displayed on a percent scale on the 3D analysis display chart.

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Animated Storage and Retrieval



The warehouse designer may want to observe how a particular item will be retrieved from the rack and delivered to the I/O point. The S/R animation gives the designer an idea about the optimal robot path, the best pick-up location for each rack as well as the accessibility of a CAD/PAD product.

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Performance Issues

To achieve a higher frame rate (FPS):

- Level-of-Detail (LOD) processing has been tried and proven to be unfeasible for our application
- Multi-source lighting has been limited to two directional light sources at infinite distance from the objects
- Objects have been modeled on Pro/E and imported into OpenGL Performer in STL format

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Conclusions

- Our "Virtual Warehouse" program allows one to construct a storage facility from scratch in VR and is currently capable of assessing existing designs for operational performance
- We are currently working on an optimization module that will calculate an optimal warehouse configuration, thus allowing the user to start with a good design and eventually reach a superior result by making personal modifications in a virtual environment

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