The Application of Virtual Reality to (Chemical Engineering) Education

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Abstract

Virtual reality, VR, offers many benefits to technical education, including the delivery of information through multiple active channels, the addressing of different learning styles, and experiential-based learning. This poster presents work performed by the authors to apply VR to engineering education, in three broad project areas: Virtual chemical plants, virtual laboratory accidents, and a virtual UIC campus. The first area provides guided exploration of domains otherwise inaccessible, such as the interior of operating reactors and microscopic reaction mechanisms. The second promotes safety by demonstrating the consequences of not following proper lab safety procedures. And the third provides valuable guidance for (foreign) visitors. All programs developed are available on the web, for free download to any interested parties.

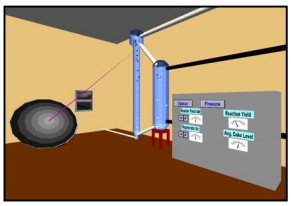
1. Introduction & Motivation

Traditional educational methods meet the needs of some students in some subjects, but they do not deliver optimal learning to all students in all subjects. VR provides opportunities to deliver technical education in ways not possible through traditional methods, thereby broadening the range of tools available to modern educators, in order to reach more students and subjects. In order to use this new tool to its optimal effectiveness, it is necessary to not only produce and deliver VR based educational simulations, but also to study the different mechanisms by which technical information can be delivered through VR and the relative effectiveness of different development and implementation platforms. The work presented here attempts to do just that, on the basis of sound educational principles.

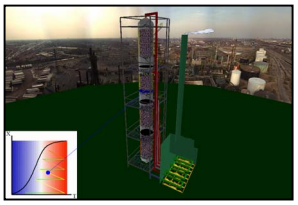
2. Virtual Chemical Plants

The first major development area was a series of virtual chemical plants, designed to reinforce topics in chemical kinetics and reactor design. Research included learning how this technology could best be applied to technological education, and which platforms were most effective.

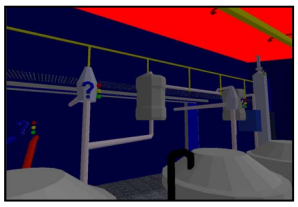
Four major chemical plants are either completed or under development, as follows:



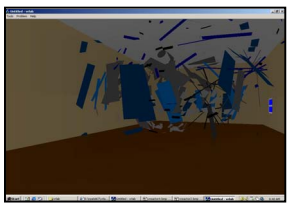
Vicher I deals with the topic of heterogeneous catalysis - Interactions of vapor or liquid reacting materials with a solid catalytic surface.



Vicher II addresses the area of non-isothermal kinetics, i.e. situations where temperature plays an important role in reactor operation.



SafeHunt is a scavenger hunt, in which students must search through a production facility to find a series of safety-related scenarios, indicated by large 3-D question marks.



Virtual Reactor Design requires students to design a reactor system and then experience the results of operating their design - good or bad!

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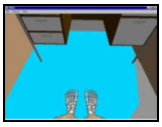
3. Virtual Laboratory Accidents

The overall goal of this project is to allow users to *experience* the consequences of not following proper lab safety procedures. Eight different accidents have been simulated, on various combinations of five different development platforms:

Always wear safety glasses in lab: An accident sprays the user, causing either blindness or goopy glasses.

Store Chemical Properly: The user has a limited time to clean up the lab and put everything away properly, before it explodes.



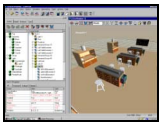
Always wear proper attire: Improper footwear or the lack of a proper lab coat can have dire consequences in a lab environment.

Keep Aisleways Clear: In the event of a fire, a clear aisleway can make the difference between exiting the lab safety or a possible fatality.

No food or drink allowed in the laboratory: Failure to heed this rule can lead to the ingestion of potentially life-threatening material.

Securely fasten compressed gas cylinders: Otherwise a broken nozzle can turn the cylinder into a highly dangerous flying torpedo.

WorldToolKit: This C-language toolkit supports multiple hardware platforms and optional devices, but requires installing compiled code.

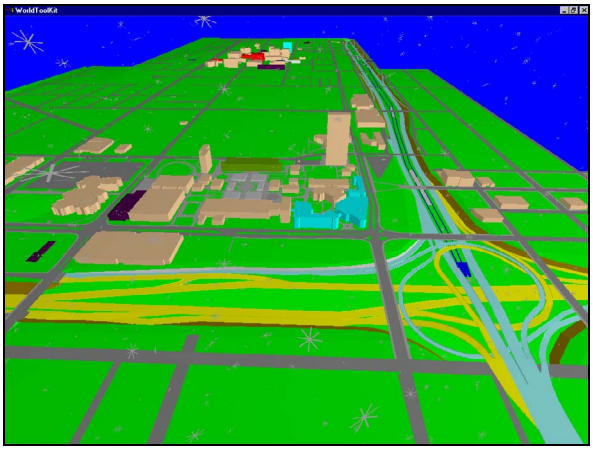


WorldUp: Provides a graphical development environment interface to WorldToolKit functions. Can be compiled or run in a web plug-in.

Java3D: This package extension to Java provides for 3-D objects, actions, and interactions. Accidents run in a web browser with a plug-in.

Half Life game engine: Based on a popular game, provides for easy environment building, explosions, fire effects, and user interactions.

4. Virtual UIC



A Campus Overview of Virtual UIC

Another project area under development in the VRUPL lab is a VR based simulation of the University of Illinois Chicago campus, and an increasing number of individual buildings and areas. This project provides initiation guidance to campus newcomers, as well as serving as an excellent starting project for new VR developers.

5. Module Access & Further Information

All (completed) applications described here are available for free access at the VRUPL web site, http://www.vrupl.evl.uic.edu.

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