low cost virtual reality aided design for the architectural education

Content:

1. **What is VR**
2. **Hardware**
3. **Software**
4. **Pipeline**

Ming Tang.

2006. ACSA Conference

Virtual Reality:

Experience a sense of “being there” without actually being ‘there”.

The key point is the user’s autonomy of movement within the virtual space (Conway Lloyd Morgan, Giuiano Zampi. 1995). With real time technology, viewers could navigate a 3D environment with external devices (joystick, mouse, keyboard or motion tracking system). The display devices such as head mount display (HMD), stereo panorama screen, and CAVE system create a fully immersive virtual environment. Also, latest web based 3D technology turned Internet into a powerful media for VR. VR Aided Design (VRAD), as “computer-aided design using the methods of virtual reality” (Holger Regenbrecht, Dirk Donath 1997), allows architects to experiment with 3D interactions while being immersed into a virtual space.

Application

Training and Education. (Fly simulation)

Communication (Tele-conference)

Scientific Simulation (etc. DNA)

Engineering, industrial production

Architecture

Historic Preservation and Archaeology

Medical operation

Media Art presentation

Entertainment, Game

Virtual Reality Experiences

Virtual Tours/Stores

Object visualization

Why use it for Architecture visualization?

First, no rendering time, quick to publish

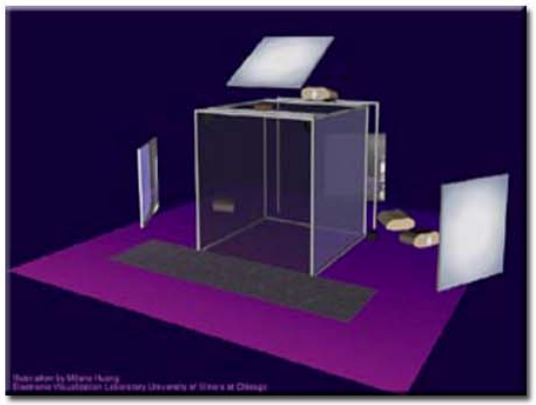
Second, give viewers freedom to navigate to any place, look at from any viewpoint.

Third, it is online. You could publish your world to Web and communicate with others.

As computer graphic card became more and more powerful, (like lots of XBOX), it will get popular.

Constrain

Typical immersive VRAD system such as HMD and motion tracking system are very expensive and not practical to be used in the studio presentations of architecture institutes. Besides the high cost, another constrain of VRAD comes from its complex script. The platform of VRAD requires advanced programming skills and writing specific script, which limited its application outside research laboratories.

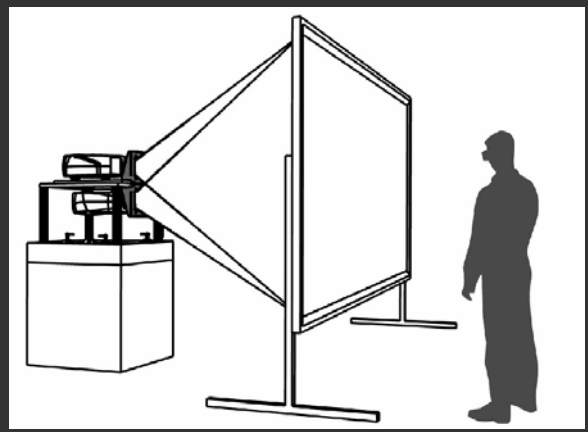


Low-Cost Virtual Reality Aided Design (LC-VRAD)?

Compared to the expensive high-end VR lab's technology, game engine is more practical for most general founded researchers and architecture institutes. "The most sophisticated rendering pipelines are now found not on specialized scientific machines but on PC video cards costing less than $500. The most sophisticated, responsive interactive simulations are now found in the engines build to power games." (Michael Lewis and Jeffrey Jacobson. 2002)

HARDWARE

Compared with “immersive VR” devices like stereoscopic display and panorama screen, “Desktop VR” only require a desktop, a big screen and a mouse /joystick. The cost of hardware is only around $ 2,500.

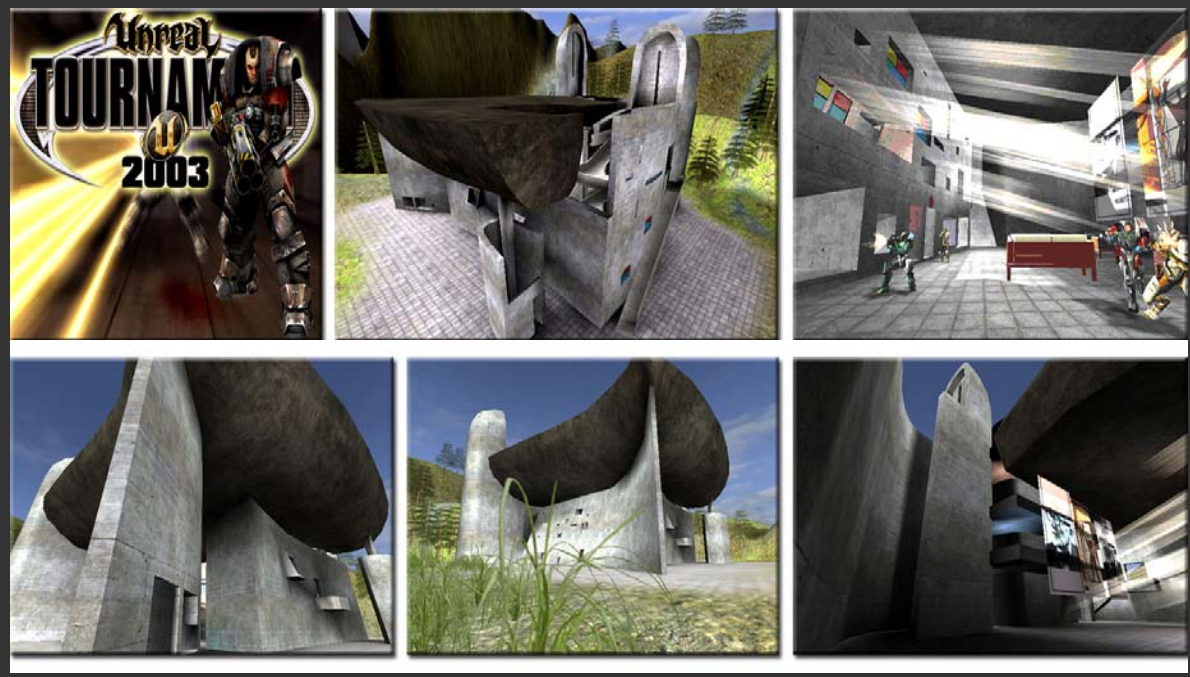


2.2 SOFTWARE

The game industry might be the quickest growing technology-intense industry now. The latest development of graphic card and rendering technology is pushing game engines into a new level. Game engines are using bump map, normal map, HDRI rendering, dynamic lighting and capable of handling very complex, high-polygon geometry with a high frame rate. Different from the early age VRML model, high quality and photorealistic real time rendering “truly blur the line between pre-rendered computer-generated film imagery and real-time rendered 3D game imagery.” (Karen Moltenbrey. 2003)

Unreal Game Engine

Epic Games' Unreal Tournament (UT) game engine is famous for its fast rendering speed, and well-designed level editing tools. UT is the most "modified" game title with over 25,000 people building their own versions of the various games in the series (Lisa Taylor, 2003).



How?

1. Software:

3D modeling tools

•Maya, 3D Studio VIZ, Micro Station, AutoCAD

3D engine

•Unreal Engine. $50

•Free none-commercial version.

•Hardware Level

Desktop systems (not high-end workstations)

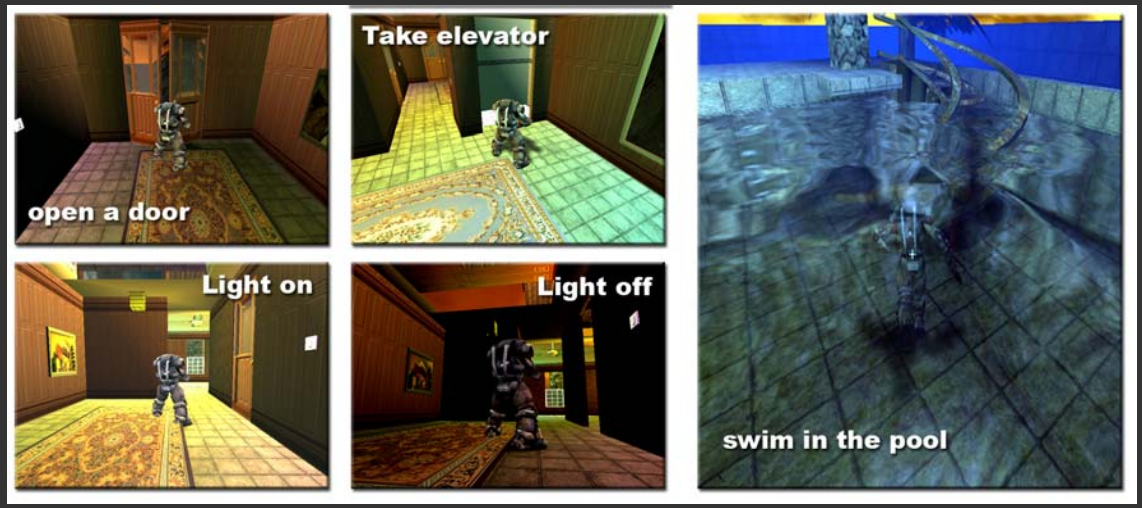
3D Accelerated Video Graphics Card

HP Workstation 8000

NVIDIA Quadro FX

Why use Unreal Engine?

1. Easy
2. Web-based.
3. Rapid Development
   Integrated Development Environment
   Powerful Programming Language
   Flexible
   Expandable
   Performance
   Handling of Media
   Self-Contained, Royalty Free Titles

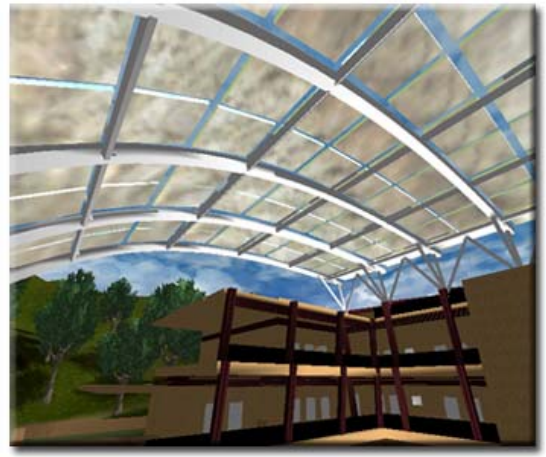


How to create?

1.Create your model in Maya, 3DSMAX (VIZ), MicroStation, AutoCAD.

2. Transfer to Director MX with w3D file. (VIZ and Maya have the export w3D file option).

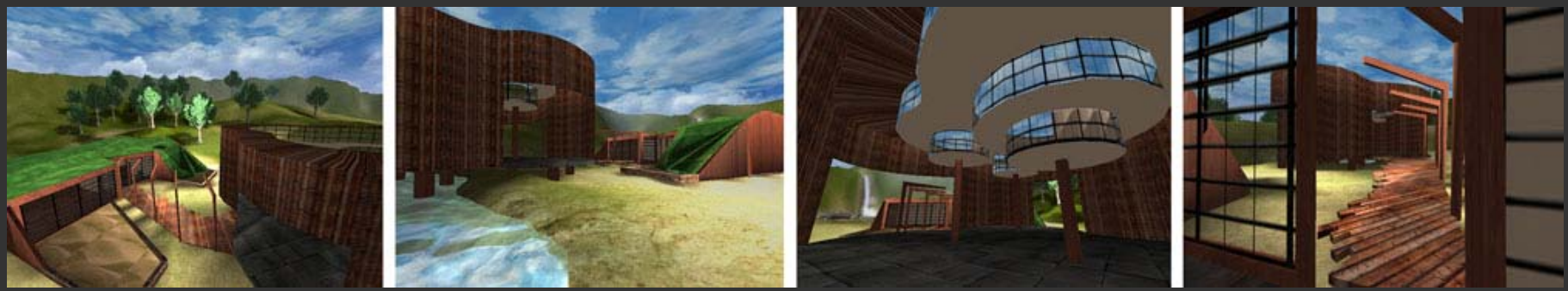
3.Publish from Director MX to Web.



Navigation of Virtual Space

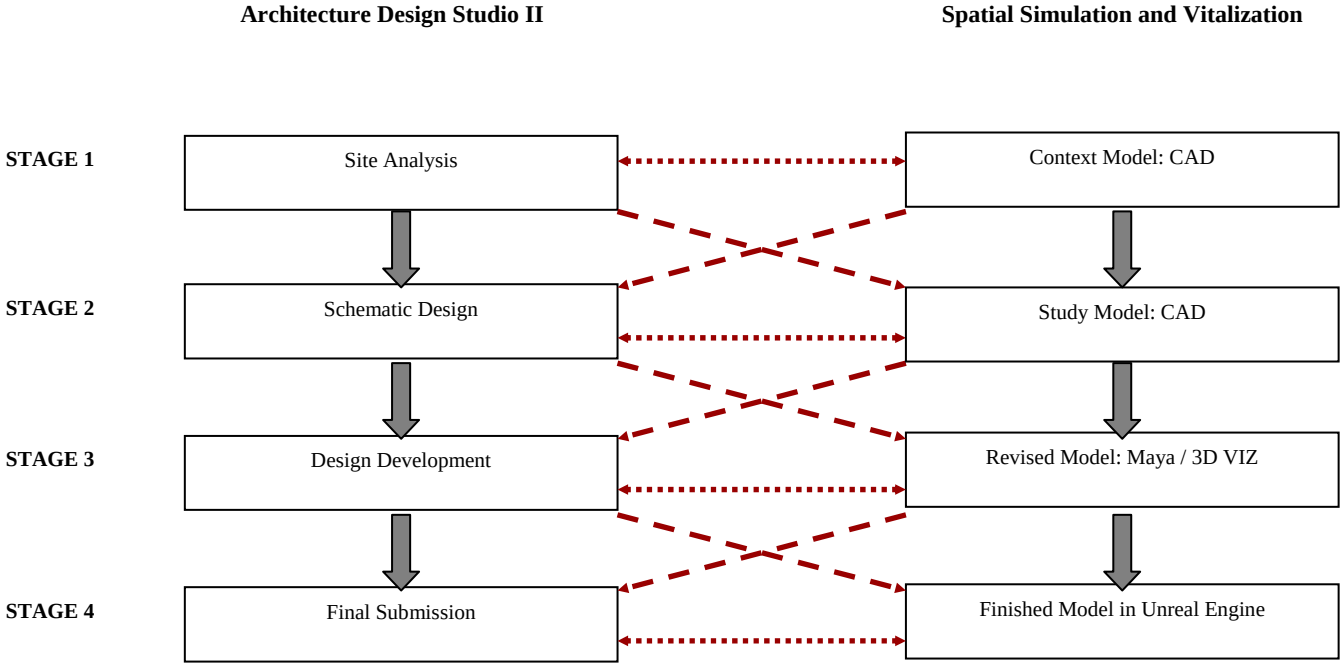
Navigation.

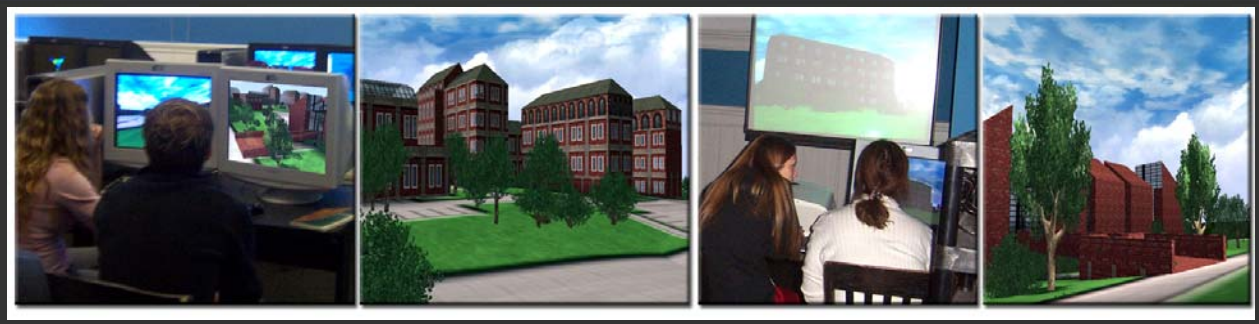
Tracking system, Keyboard, Mouse, Joystick



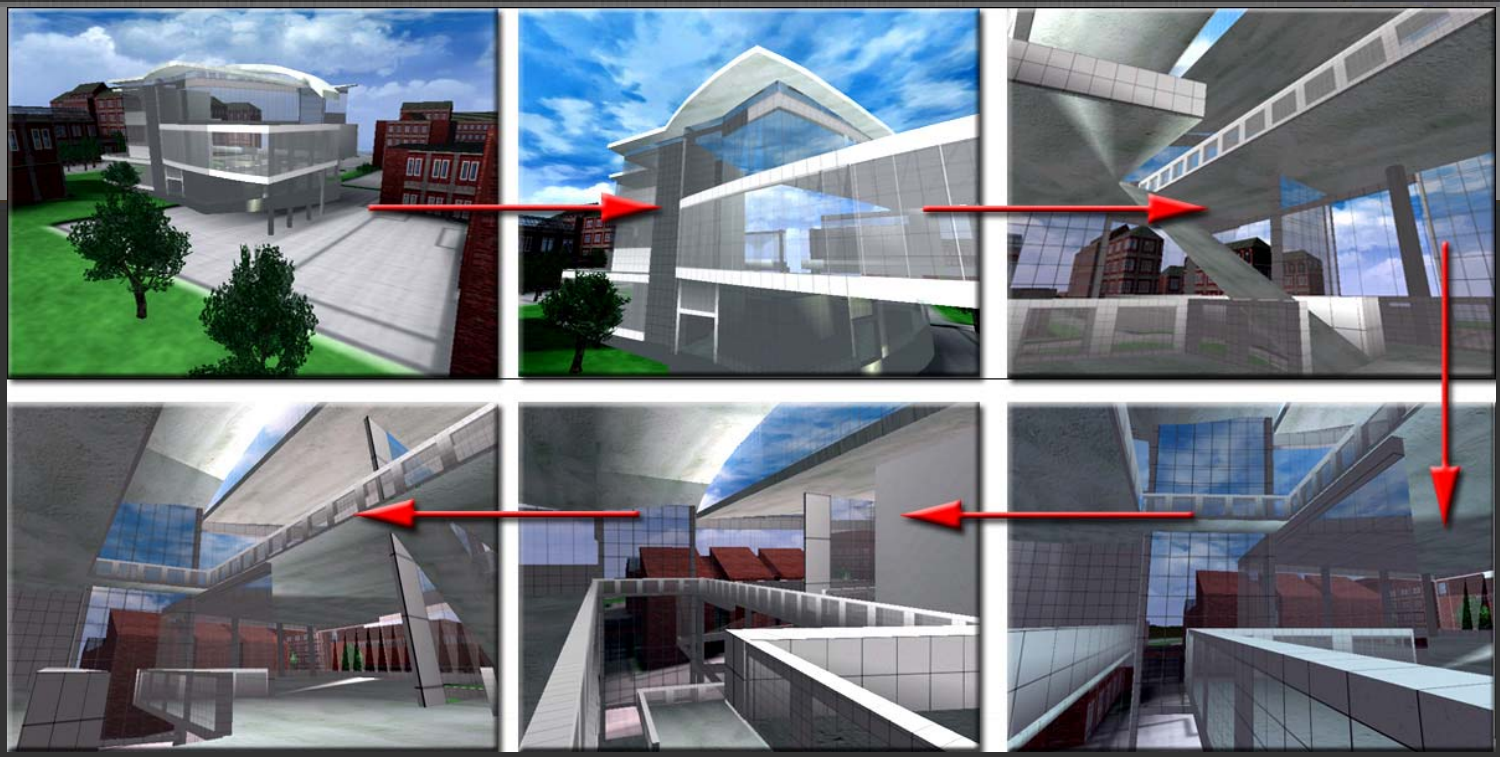
Topography, Space Motion, a real time four dimensional experience (XYZ + Time)

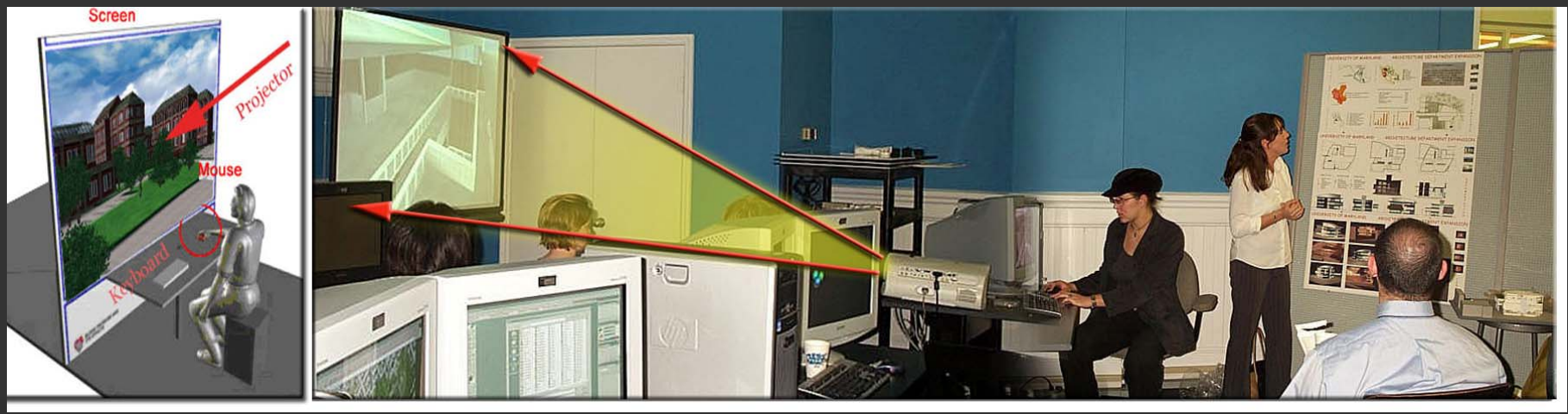
Real time engine name	Player name	Edit tools	View through internet?	File format	Good / bad
VRML	Cosm-vrml player	No. direct output from 3D software	y	vrml	Easy to generate No shadows Easy navigation
Director MX	Shockwave player	Director MX	y	w3d	Easy to generate No shadows Advanced interactivity. Animated texture
Unreal -2	Unreal game installed	Unreal Editor	n	UTX	Complex Photo realistic shadows Special effects, lighting Complex to generate Need game installed

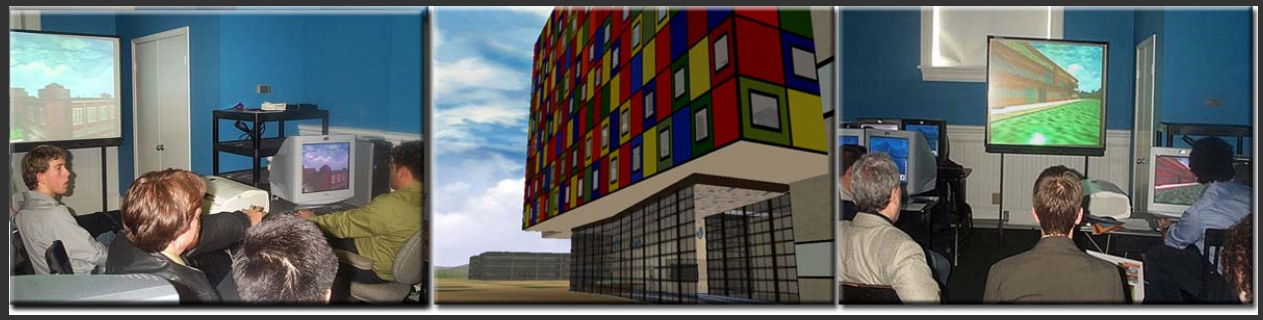

Architecture Design Studio II
Spatial Simulation and Vitalization
STAGE 1
STAGE 2
STAGE 3
STAGE 4
Site Analysis
Schematic Design
Design Development
Final Submission
Context Model: CAD
Study Model: CAD
Revised Model: Maya / 3D VIZ
Finished Model in Unreal Engine

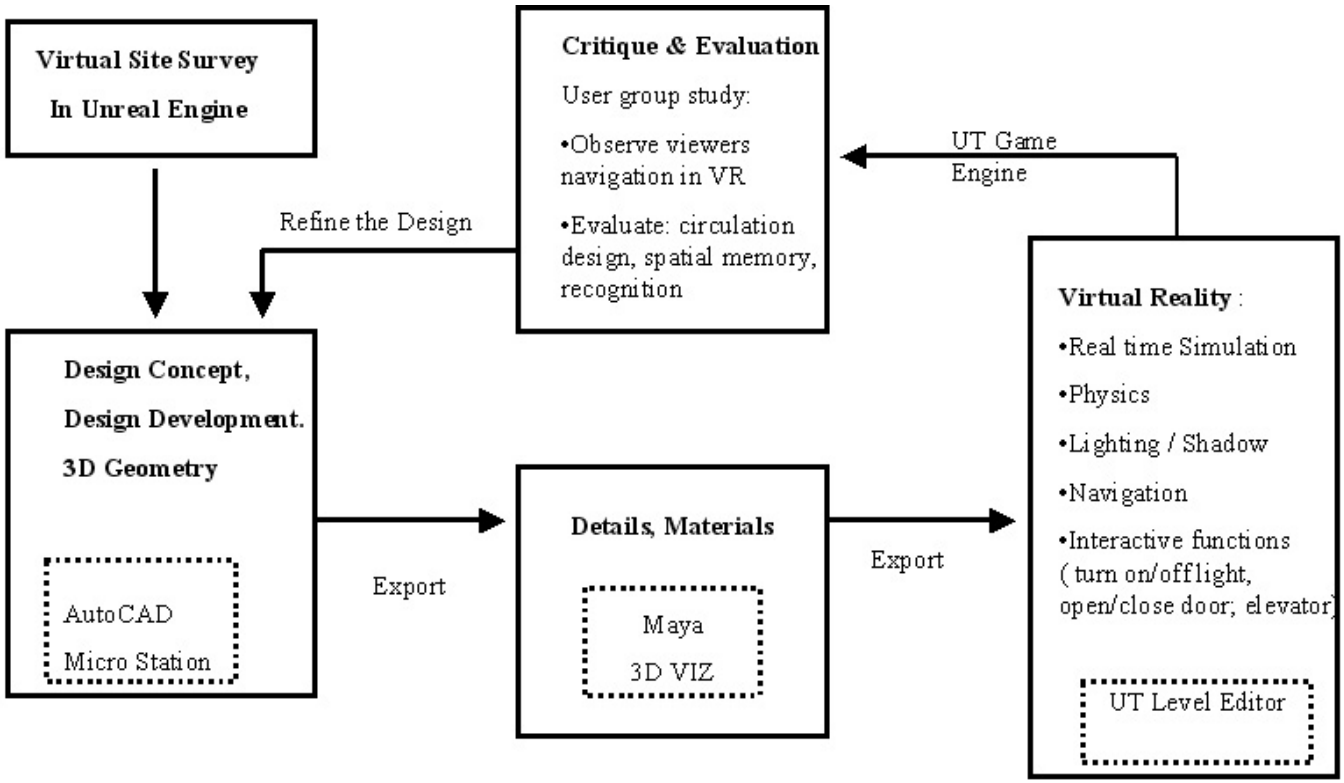


UMCP Studio Project




Screen
Projector
Mouse
Keyboard




Virtual Site Survey
In Unreal Engine
Critique & Evaluation
User group study:
•Observe viewers navigation in VR
•Evaluate: circulation design, spatial memory, recognition
UT Game Engine
Refine the Design
Design Concept,
Design Development.
3D Geometry
AutoCAD
Micro Station
Export
Details, Materials
Maya
3D VIZ
Export
Virtual Reality :
•Real time Simulation
•Physics
•Lighting / Shadow
•Navigation
•Interactive functions (turn on/off light, open/close door; elevator)
UT Level Editor