



Collaborative 3D Content Creation

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Overview


- Introduction
 - CoViD
- Conceptual 3D design
 - MIVE, Virtual Lego, and SESAME
- Collaborative work
 - MULTI, Multi-User Laser Pointers
- List of other research projects

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Collaborative Virtual Design - Vision

A group of people

- with different backgrounds
- from different disciplines
- with different computer skills



aided in their collaboration by a computer-based system

My research: Collaborative Virtual Design (CoViD)

- Collaborative work on 3D digital content
 - Needed in many application domains

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3D Content

3D digital models today basis for many industries
 Everything that requires:

- Industrial/mechanical design, simulations, training environments, animation, entertainment

Today, 3D design via (very) complicated software

- Only specialists can learn these tools
- Focus on later stages of design - “detailing”
- Not adequate for early stages - “conceptual”
 - Here is where collaboration happens!

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Requirements Analysis for Conceptual Design

(J.-Y. Oh)

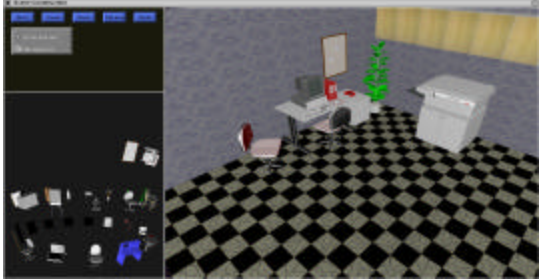
Conceptual design session for 3D requires

- Quick visualization of virtual 3D objects
- Simple manipulation
 - Preferably with 2D devices
 - 6DOF/3DOF devices problematic
- Rapid exploration of several *different* ideas
- Support for incremental and *structural* changes

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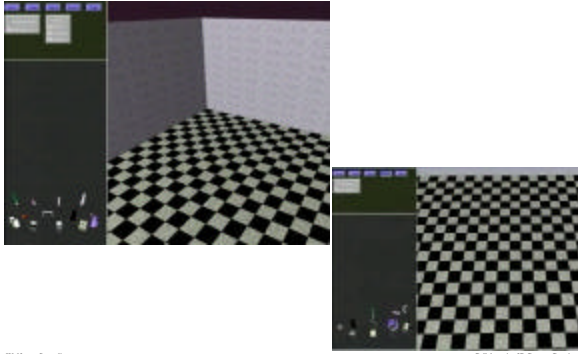
MIVE - Multi-User Intuitive Virtual Environment

- Simple and efficient manipulation of 3D environment.



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MIVE Videos



Revised Goals

Users of MIVE wanted modification of objects, too

First idea: Emulate good properties of Lego™

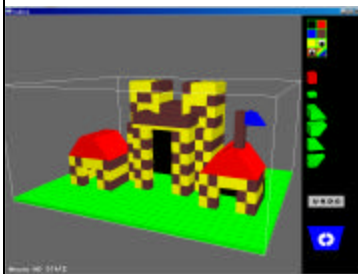
- Easy to use
- Quick creation of approximate 3D models
- Sliding & snapping of solid blocks
- Easy re-arrangement of *arbitrary* parts
- Fun to play with!

Lego used to prototype for VR (Neale 2002)

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Virtual Lego

Based on Lego paradigm, with improvements



- 3-button mouse
- Blocks slide on visible surfaces
- View dependent manipulation
- Grouping technique for composite object manipulation

Virtual Lego Video

Virtual Lego™

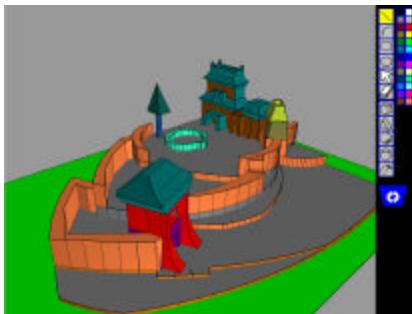
**Easy Scene
Construction
& Modification**

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SESAME - Sketch, Extrude, Sculpt And Manipulate Easily

Evolution of
Virtual Lego
(J.-Y. Oh)

Supports
arbitrary
geometry



SESAME Video

SESAME

(Sketch, Extrude, Sculpt, and Manipulate Easily)

A 3D Conceptual Design System

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Other Features

Grouping similar to Virtual Lego

- With improvements

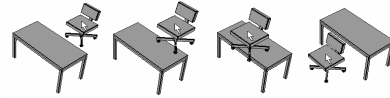
New 3D movement technique

- Slide on foremost surface *behind* moving object
- Supported by perception research
- Traditional technique (using mouse cursor pos.):

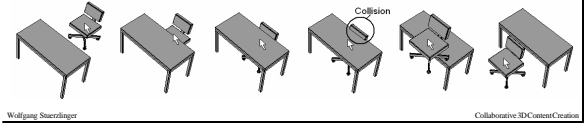


Moving Objects in 3D (1)

New technique (using moving object area)



Modification (using foremost plane behind moving object)



Moving Objects in 3D (2)

Speed computations with graphics hardware

- 1) Render scene without moving object & save
- 2) Render backfaces of moving object
- 3) Location of min. depth difference used to compute new 3D position
- 4) Re-render object at new location. If collision, use min. depth diff. to shift object to front

Modified technique ignores objects closer to viewer relative to moving object

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SESAME 3D Movement Video

Moving Objects in 3D
Using a Mouse

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Evaluation

Graduate architecture students with avg. 3 years experience with paper sketching or 3DStudio Max

- First-time use of SESAME

Task: design building(s) on "A"

Study in collaboration with J. Danahy, UoT



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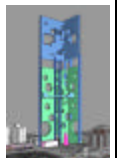
Comparison Results

3DS Max vs. SESAME

- Significantly faster
- Significantly more creative

Paper sketching vs. SESAME

- No significant differences
- SESAME provides better understanding of space
- Sketching provides better understanding of function of building



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Designers at Work



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Content Creation

Obstacles for Collaborative Design

- Most applications require significant training
 - “Solved” with MIVE, Virtual Lego, & SESAME
- Input devices are single-user
 - Hard to have more than one pointing device
- Graphical user interface & OS is single-user
 - Designed for one “communication channel”
- Output devices are single-user
 - Monitor too small for effective collaboration

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Single/Shared Display Groupware

Systems designed to enhance collaboration

- Via one (or more) large interactive display(s)
 - Wall, tabletop, etc.

Interaction usually only directly on screen

- Limits everything to single “driver”

How to support multiple input/output streams?

- Laptop/PDA for each user doesn't work

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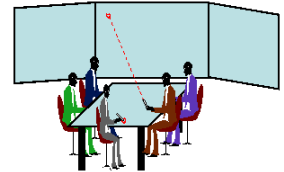
MULTI

(Multi-User Laser Table Interface)

(A. Pavlovych, A. Vorozcovs)

Platform for collaborative work

- 1 interactive table
- 3 interactive walls

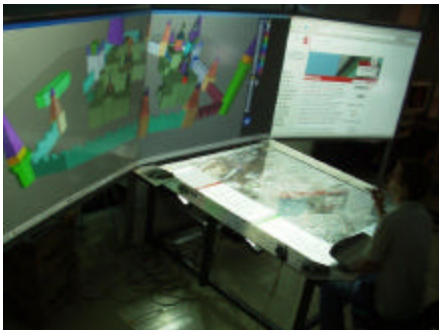


Laser pointers for input

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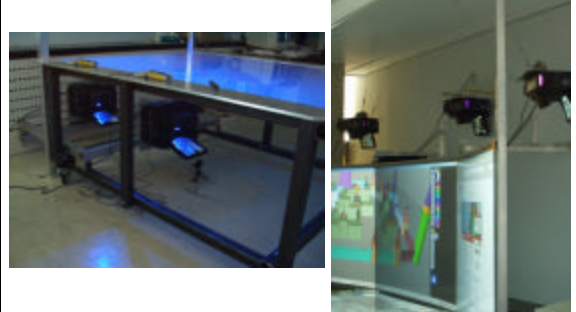
MULTI Image



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MULTI Details



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Multi-User Laser Pointers

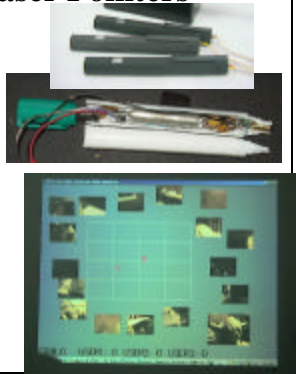
Computer controlled laser pointers as input devices

- Wired or wireless

Both remote *and* local pointing - i.e. as stylus on back-projected display!

Laser identification useful

- Undo, playback, etc.
- Groupware



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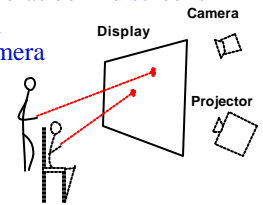
How to Identify Lasers

Laser spots observed by cameras behind screens

Laser blinking synchronized with acquisition rate of camera

Identification schemes

- Single laser per cycle
- Grey code
 - Uneven brightness
- Single laser per cycle + turn all lasers on outside of camera shutter time
 - Better brightness
- “Laser saver” (similar to screen saver)



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Future Work on Collaborative Virtual Design (CoViD)

Extensions to SESAME

- Currently analyzing requirements

Finish building MULTI

- Optimize system
- Add tangible user interface

Port MIVE, Virtual Lego & SESAME to MULTI

Verify that MULTI really works

- Evaluation with groups

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Some Other Research Projects

- Virtual Reality systems: IVY (= 6sided CAVE)
 - Tracking with Hedgehog (A. Vorozcovs)
- High-Dynamic Range display/projection systems
- Behavioral training with mobile devices
- Text entry
 - LessTap, Text entry for novices, Whiteboards (A. Pavlovych)
- Pointing
 - Steering law, etc. (S. Kulikov, S. MacKenzie)

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Thanks

- My students (see ISRG pages)
- My collaborators (UoT, UBC, Seneca, York, ...)
- Funding by NSERC, IRIS, CREStech, CFI, ...

For more information:

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Questions?

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