

An Interactive, Remote-Controlled Computer Projection System for Use in a Large Classroom Environment

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Effective Teaching and Learning: Small-Group Settings

- Instructor can easily interact with students
 - ◆ Meet their individual needs
- Few physical/psychological barriers
- Intimacy permits an easy exchange of ideas
 - ◆ Teacher shows individuals how to perform tasks
 - ◆ Any student can easily get the teacher's attention

BUT...

- Dramatic increase in student numbers
- Budgetary constraints
- Difficult for educators to use small-group teaching
- Instead large lecture room environments
- Especially in post-secondary education

Large Lecture Hall Settings

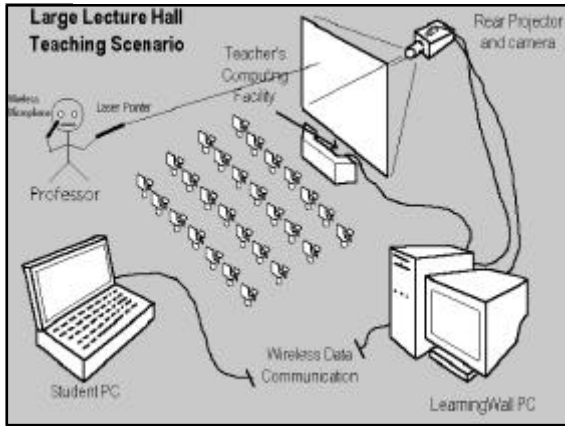
- Advantages of small-group teaching are lost
- Instructor usually positioned at the front of room, far from audience
- Computer projection systems often used
 - ◆ Mouse and keyboard tether instructor to computer
 - ◆ Cannot interact well with students
 - ◆ Remote students can't readily ask questions and clarify doubts
 - ◆ Virtually impossible for teacher to come to individuals to show them techniques

The Interactive Learning Wall

- A Windows/PC-based "virtual blackboard"
- Can be controlled at a distance by a classroom instructor and/or students

System Components

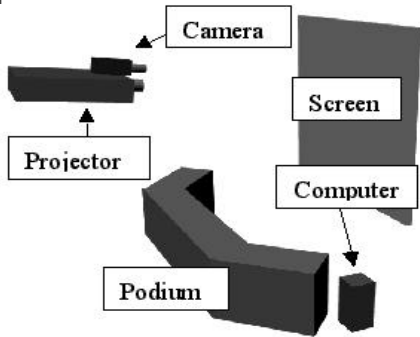
1. Wireless Mouse Emulation Software
 - ◆ Implemented with a software-controlled standard red laser pointer
 - ◆ Frees instructor to roam classroom and interact with students
2. Inter-Computer Communication Software
 - ◆ Permits communication between student and instructor computers over a LAN
 - ◆ Students can take control of the main computer's mouse and keyboard.



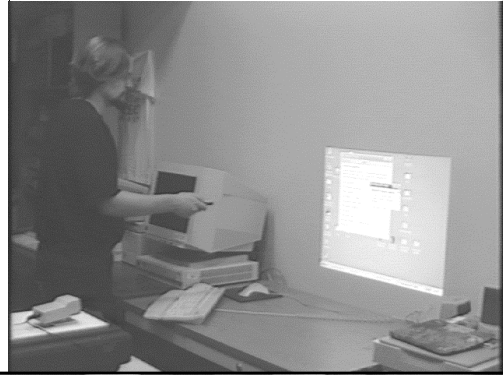
Any Student Can Do Things Like:

- Go to a specific slide in the presentation to ask a question about that slide
- Type text on main screen
- Run a simulation on instructor's computer
- Take charge of the presentation
- Annotate a diagram on main screen
- Many other possibilities

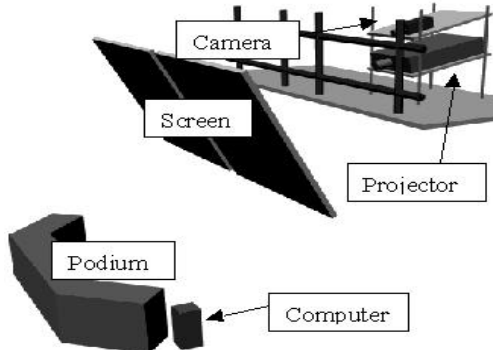
Physical Setup: Front Screen



Front-Screen Setup in Action



Physical Setup: Rear Screen



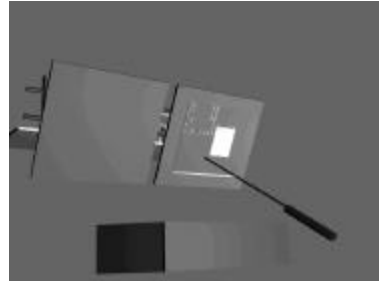
Rear-Screen Setup in Action



Laser Pointer Mouse Emulation System

- Standard data projector projects instructor's computer content to large front screen
- Instructor uses laser pointer to point at and interact with screen material
 - ◆ Reminiscent of mouse interaction
- Video camera sends each new frame to video capture card in the computer

Laser Pointer Operation



How Mouse Emulation Software Works

- Position of beam determined by examining intensity of every point in camera view area
- Camera coordinates converted to screen coordinates
- Depending on user action, appropriate Windows "mouse messages" are sent
 - ◆ makes a mouse cursor image move according to user actions with the laser pointer

Generating a Mouse Click

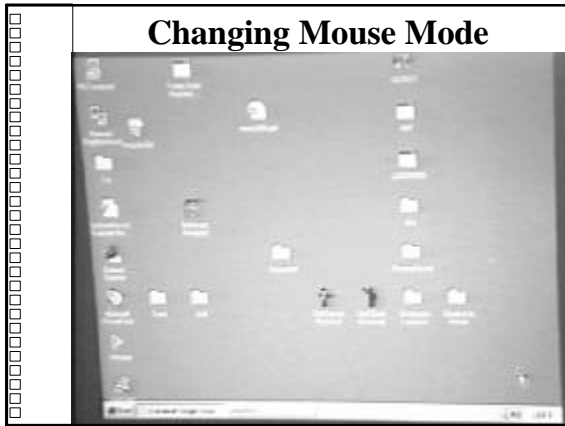
1. Press and release laser pointer button
 2. Press again within one second in close proximity to previous location
- First time beam is seen as an "aim"
 - Second is a "fire"
 - Procedure facilitates achieving accuracy at a distance despite jitter of the user's hand

Double Clicks and Mouse Moves

- Double Click
 - ◆ Repeat "click" process
- Mouse Move
 - ◆ Any time position of beam changes, mouse cursor icon instantly moved to new position on screen

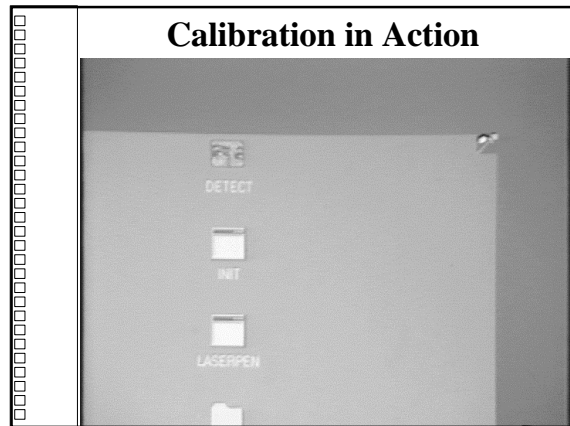
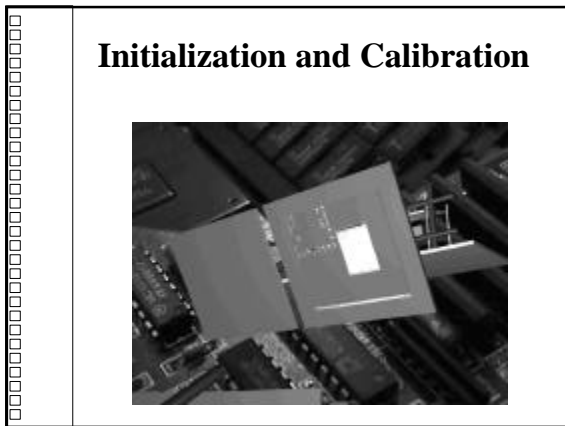
Mouse Operation Modes

- Small white box at lower right shows the current mode of operation
 - ◆ LEFT: Emulate left mouse button clicks (default)
 - ◆ RIGHT: Emulate right mouse button clicks
 - ◆ DRAW: User can sketch on screen
- Changing modes
 - ◆ Press and releasing the laser pointer button while beam is inside box



Initialization and Calibration

- In a perfect environment:
 - ◆ Camera would see exactly what projector sees
 - ◆ All pixels would be same size and shape
- Not the case
- So an initializing calibration procedure needs to be performed (one time)
 - ◆ User points and “clicks” laser pointer at four target points at the corners of the screen image
 - ◆ Software sets up the data structures to do conversions from camera to screen coordinates

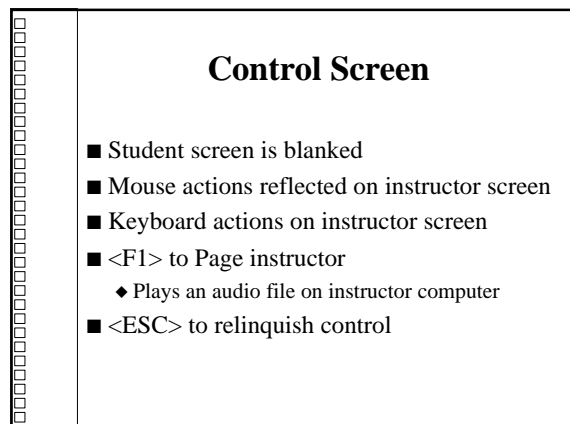
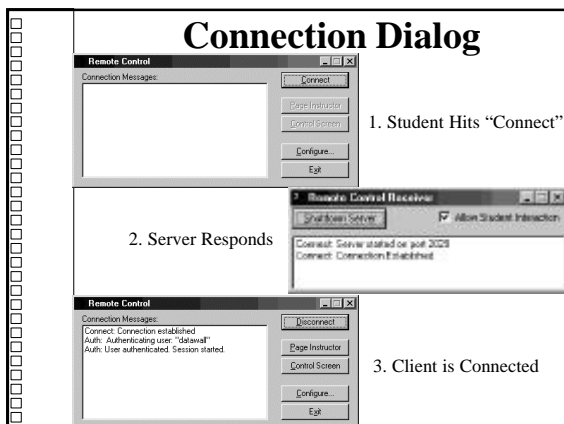
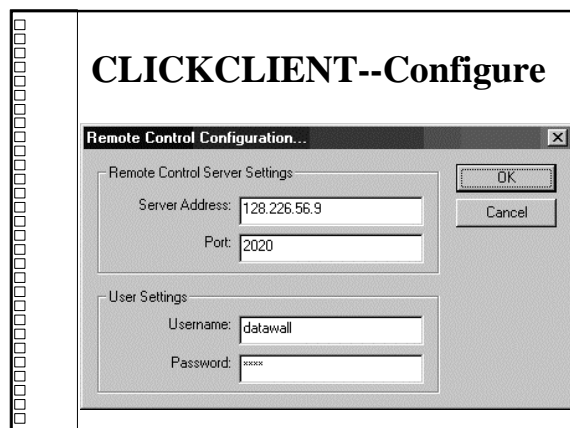
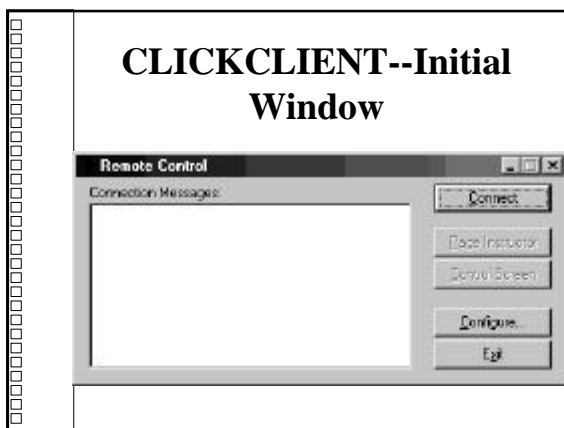
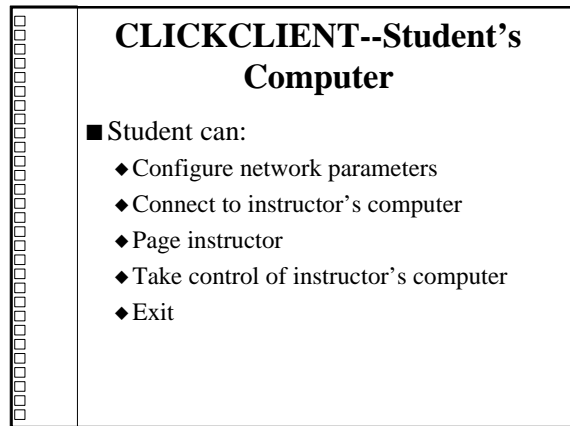
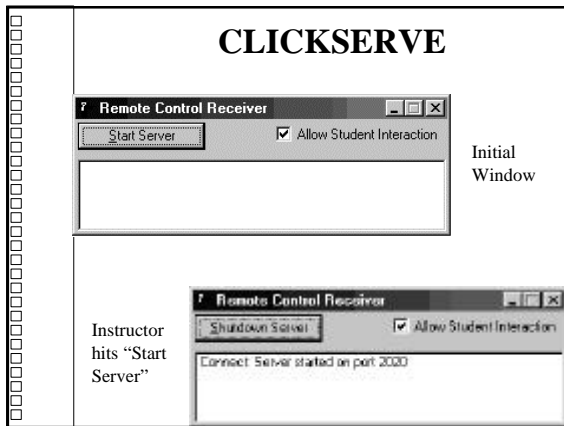


Inter-Computer Communication System

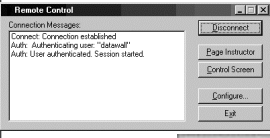
- Many classrooms have network connectivity
 - ◆ Alternative: Wireless LAN
- Want student control of the instructor's mouse and keyboard over network
- Two custom pieces of Windows software
 - ◆ CLICKSERVE runs on instructor's computer
 - ◆ CLICKCLIENT runs on each student laptop

CLICKSERVE--Instructor's Computer

- Instructor presented with a minimizable window
- Provides option of accepting or denying student connections
 - ◆ Gives flexibility of being able to decide when student intervention is most convenient or warranted



Student Gains Control

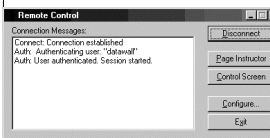


1. Student Clicks
"Control Screen"

2. Student screen is blanked:

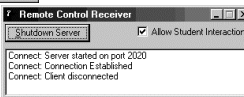
3. Student now in control of instructor's mouse and keyboard

Student Disconnects



1. Student hits "Disconnect"

2. Server disconnects student



3. Student is Advised

Conclusions

- System tried by several people
- Found learning curve to be relatively slight
 - ◆ Most of time spent learning laser "click" sequence

Future Work--New Features

- Alternative video capture cards
- Screen transferal over network connection
 - ◆ Enable download of the main screen to student laptops
 - ◆ Make it easier for students to use system
 - ◆ Enable copying and pasting of information from the teacher's machine
- Better authorization/control system
- Voice Command Recognition

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