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
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
Changing Mouse Mode

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

Initialization and Calibration

Calibration in Action

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
CLICKSERVE

Instructor hits "Start Server"

CLICKCLIENT--Student’s Computer

- Student can:
  - Configure network parameters
  - Connect to instructor’s computer
  - Page instructor
  - Take control of instructor’s computer
  - Exit

CLICKCLIENT--Initial Window

CLICKCLIENT--Configure

Connection Dialog

1. Student Hits “Connect”

2. Server Responds

3. Client is Connected

Control Screen

- Student screen is blanked
- Mouse actions reflected on instructor screen
- Keyboard actions on instructor screen
- <F1> to Page instructor
- <ESC> to relinquish control
**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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This project was made possible in part by an AFOSR grant.