

Distributed Application Launching for High Quality Graphics in Synchronous Distance Education

J. Mark Pullen and Jim X. Chen
Department of Computer Science and C⁴I Center
George Mason University
Fairfax, VA, 22030, USA
{mpullen,jchen}@cs.gmu.edu
<http://netlab.gmu.edu>

Overview

- Context
- Existing software
- Application launching
- Teaching experience
- Conclusions

Context

- Synchronous sessions
 - Recorded for asynchronous review
 - Simultaneous classroom and online delivery
- Purpose
 - Improve access for regional students
 - Telecommuting to class
- Moderate capacity Internet connections
 - 56k modem up to a few 100 kb/s
- Locally integrated open source multimedia software “Network EducationWare” (NEW)
 - Web-based interface
 - Enabled experimental application launching

Goals of *NEW*

1. Maximize accessibility of live classes over the Internet while preserving interaction
 - Usable with 56K modem or better connection
 - Remote student receives same voice and graphic as classroom student
 - Imperceptible delay
 - Optional video
 - needs better network connection
 - Class available in real time or afterward from recording
 - “Space-shift” or “time-shift” attendance

Goals of *NEW*

2. Minimize effort and cost to students, faculty and supporting institution
 - Runs on typical student PC or laptop
 - Inexpensive Linux or Windows server
 - No charge for software
 - Authoring in any graphic tool
 - Use existing slides
 - “Simulteaching” model lets network students attend an existing in-classroom course
 - No need to pay for another delivery

The *Simulteaching* Model

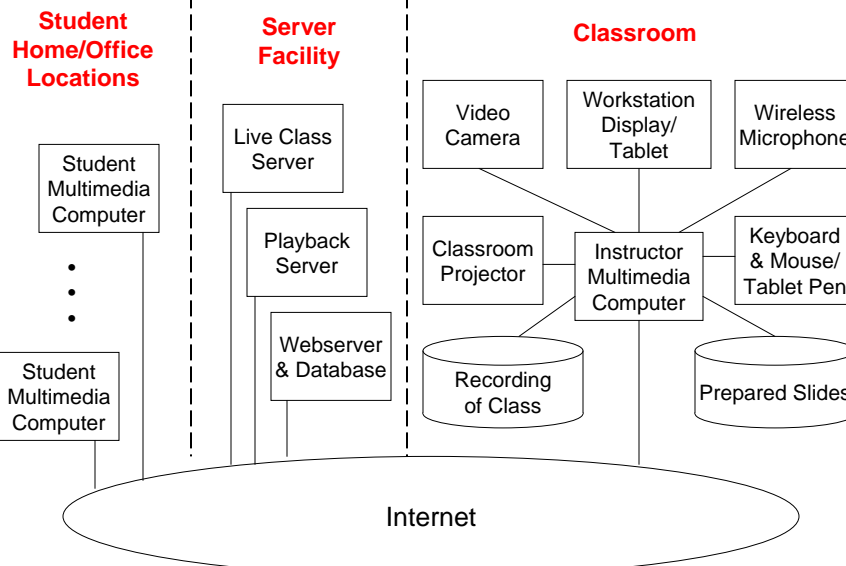
- Regional online course delivery
 - Avoids long travel time to attend class
- Students may attend in-person or online
 - or time-delayed via recording
- Classroom and online students have equal access to class and opportunity for interaction
- Low-cost approach
 - No new webpages to create; use existing slides
 - Teaching two groups at same time lowers costs
 - Video benefit marginal
 - Major cost is Internet connection
 - Should provide if network is available

Network EducationWare (*NEW*)

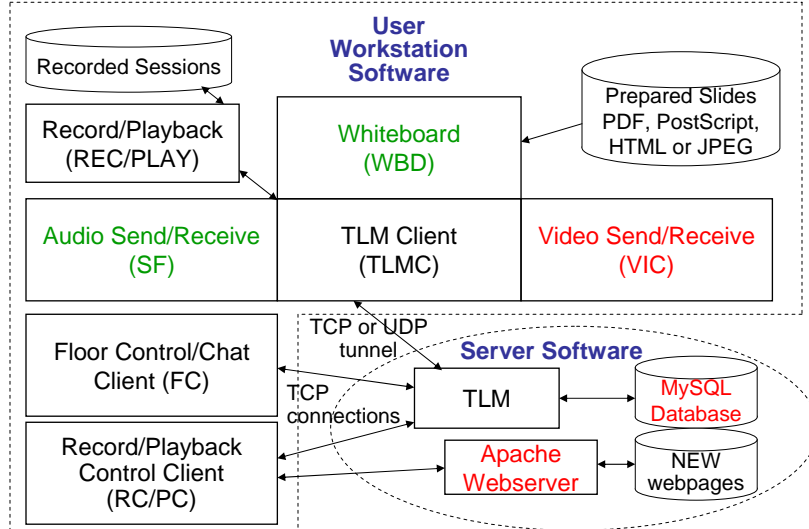
Open Source Online Teaching Software

- Based on freely available Internet multimedia/multicasting software
 - Audio/whiteboard/video
 - Control software by GMU
- Client package for Windows and Linux
 - Porting to Macintosh platform
- Server package in Java runs on any platform
 - Software supports client multicasting
 - Uses TCP tunnels to deal with NAT
- Web-based access and course management

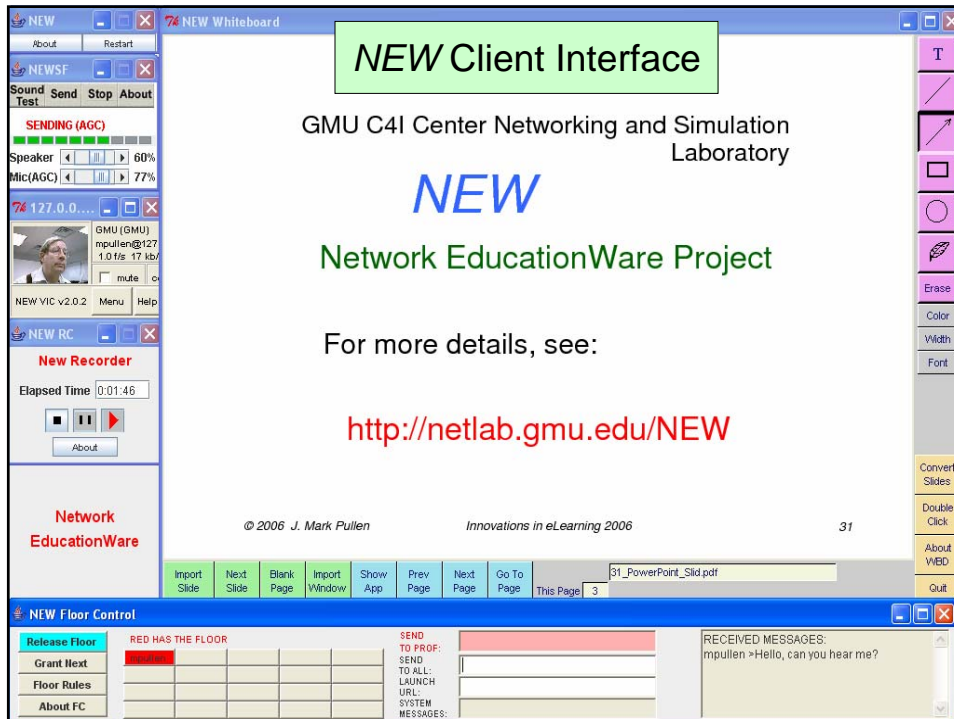
Simulteaching System



NEW Open Source Software



Off-the-shelf Open Source GMU-modified Open Source GMU-built Open Source



NEW Client Interface

GMU C4I Center Networking and Simulation Laboratory

NEW

Network EducationWare Project

For more details, see:

<http://netlab.gmu.edu/NEW>

© 2006 J. Mark Pullen Innovations in eLearning 2006 31

The screenshot shows a window titled "NEW Whiteboard" with a toolbar on the right containing icons for text, eraser, color, width, font, convert slides, double click, about WBD, and quit. The main area displays the text above. At the bottom, there is a "NEW Floor Control" window with a "Release Floor" button, a "RED HAS THE FLOOR" indicator, and a "SEND TO FROF:" field. A "RECEIVED MESSAGES:" window shows a message: "mpullen >Hello, can you hear me?".

NEW Web Portal

- Simple interface to complex functions
 - Software load and test
 - Live access
 - Multiple client configurations from webpage
 - Playback
 - Multiple client configurations from webpage
 - Chat rooms
- Focal point for course management
 - For instructors, database management and statistics
 - For administrators, server and webpage management
- Scalability
- **NEW** won international competition for non-commercial Web-based education software

The screenshot shows a web browser window titled "Distance Education Welcome Webpage - Mozilla Firefox". The address bar shows the URL "https://netlab.gmu.edu/disted/welcome.php". The page content is titled "Network EducationWare" and "Welcome to the NEW Distance Education System". It displays the current semester as "Spring 2008" and the course as "IT657-2", with the instructor listed as "J M Pullen". The interface is divided into several sections with radio button options and dropdown menus:

- Select:**
 - Preparation:** Download/install software, Test your connection, Download application data.
 - Live Class Connection:** A dropdown menu.
 - Communication:** Email all IT657 students, Email IT657-2 (net) students.
 - Review:** Streaming playback, Download playback, Download class slides.
- Course Files:** Manage Slides, Manage Recordings, Manage Application Data (with a dropdown menu).
- Courses:** submit, delete, View course roster, Add student, Update/delete student, View course status, Add/update session, View course statistics.

A left-hand menu contains links for FAQs, Report a problem, Getting Started, Project, Admin Functions, Instructor FAQs, Instructor Notes, Quick Guide, Report bugs, and Log off. The status bar at the bottom shows "Done" and the URL "netlab.gmu.edu".

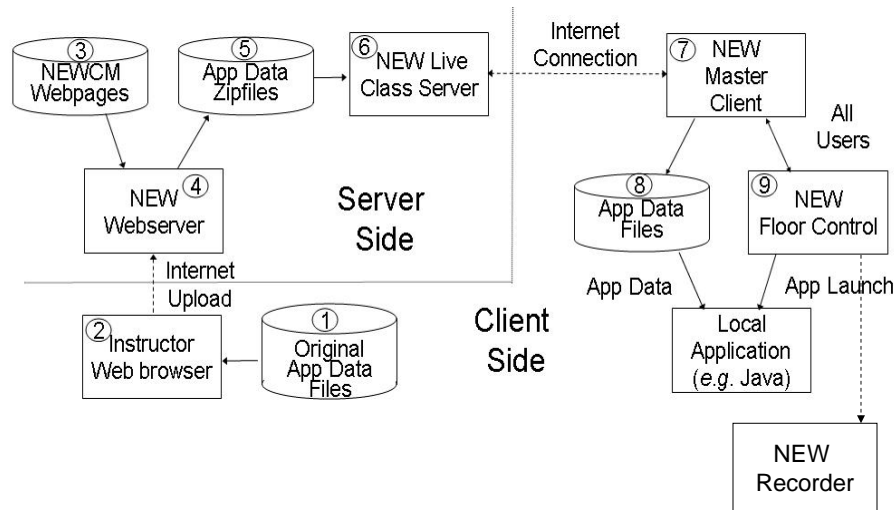
Application Sharing in Online CS Teaching

- Common requirement
 - Demonstrate operation of software
- Existing generic approach
 - Export image of a display window in real time
 - Microsoft LiveMeeting (commercial)
 - VNC (open source)
 - NEW Whiteboard window capture (integrated)
 - Must have high network capacity or update slowly
- Alternative we explored: application launching
 - Download data files and execute on student computer
 - Launch application everywhere on instructor command

Application Launching Strategy

- Modified client and server floor control
 - Java code with per-user threads
- Instructor uploads data files to server
 - Done before class, using webpage interface; zipped by server
- Server streams data files to student floor control in background if not already present
 - Includes a configuration list of known applications
 - Can be Java classes, which are “data” to the Java VM
 - Floor control display shows download status
 - Students with limited network connections can download before class via webpage interface
- Client software launches applications with data files selected by the instructor
 - Runs in real time with high graphic quality
 - Data files and run commands included in NEW recording

Application Launching Design



Practical Issues

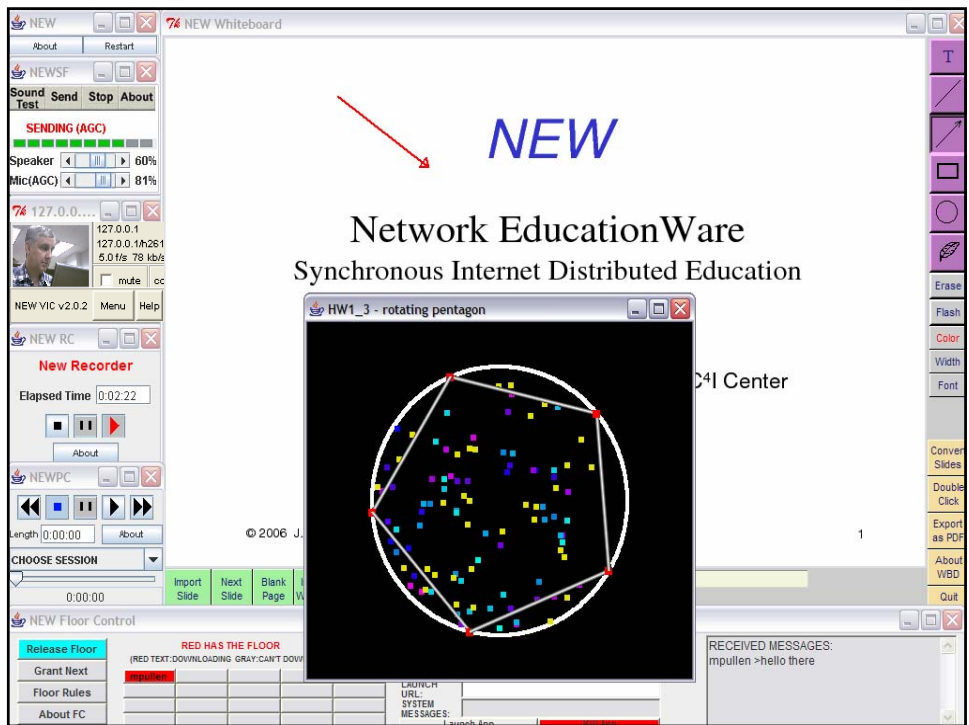
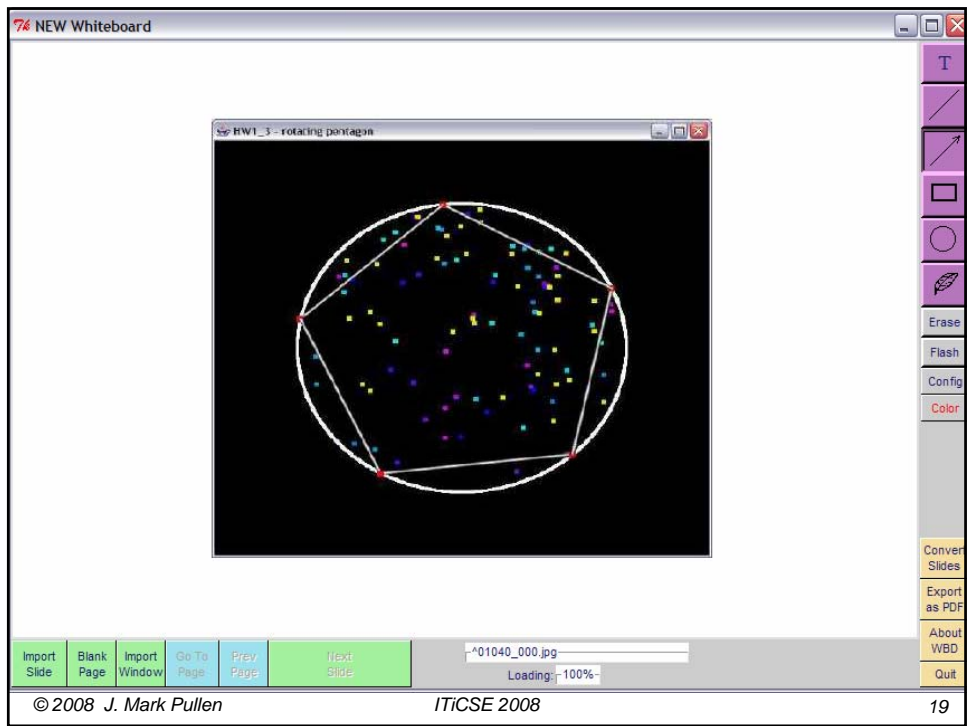
- Security
 - Student must trust instructor not to include malware
 - Issue similar to download of software in general
 - NEW is configured to allow only instructors to load the data files
- Limitation
 - Not possible to enter local runtime input on remote computers; only data files

Application Launching for a Computer Graphics Course

- Teaching computer graphics demands high quality, motion output
 - Not previously possible using NEW
- Chen's course covers graphics in breadth
 - Graphics hardware, antialiasing, transformations, viewing, illumination, blending, texture mapping, color models, curves, surfaces, scene graph structure, and virtual environments
- Chen has authored computer graphics text which includes Java Open Graphics Library 3D animation examples
 - Well suited for Application Launching

Teaching Experience

- We collaborated on the new approach
 - Pullen's lab developed delivery software (Windows and Linux)
 - Chen shaped software as it developed and used it to teach Computer Graphics online
- First tried NEW window capture
 - Resolution barely acceptable
 - Motion not effective
- Then modified the Floor Control as described in this paper
 - Teaching and learning experience fully satisfactory



Conclusions

- Application launching is an effective substitute for application sharing in teaching Computer Graphics
- Pilot course used the technique successfully
- Added confidence in use of *NEW* to extend the classroom to regional students
- Expanded our online MSCS

GMU C4I Center Networking and Simulation
Laboratory

NEW

Network EducationWare Project

For more details, see:

<http://netlab.gmu.edu/NEW>