Distributed Application Launching for High Quality Graphics in Synchronous Distance Education

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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
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
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
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
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

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NEW

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