Effective Distance Learning Through Sustained Interactivity and Visual Realism

Presented by Chun Jia

Organization

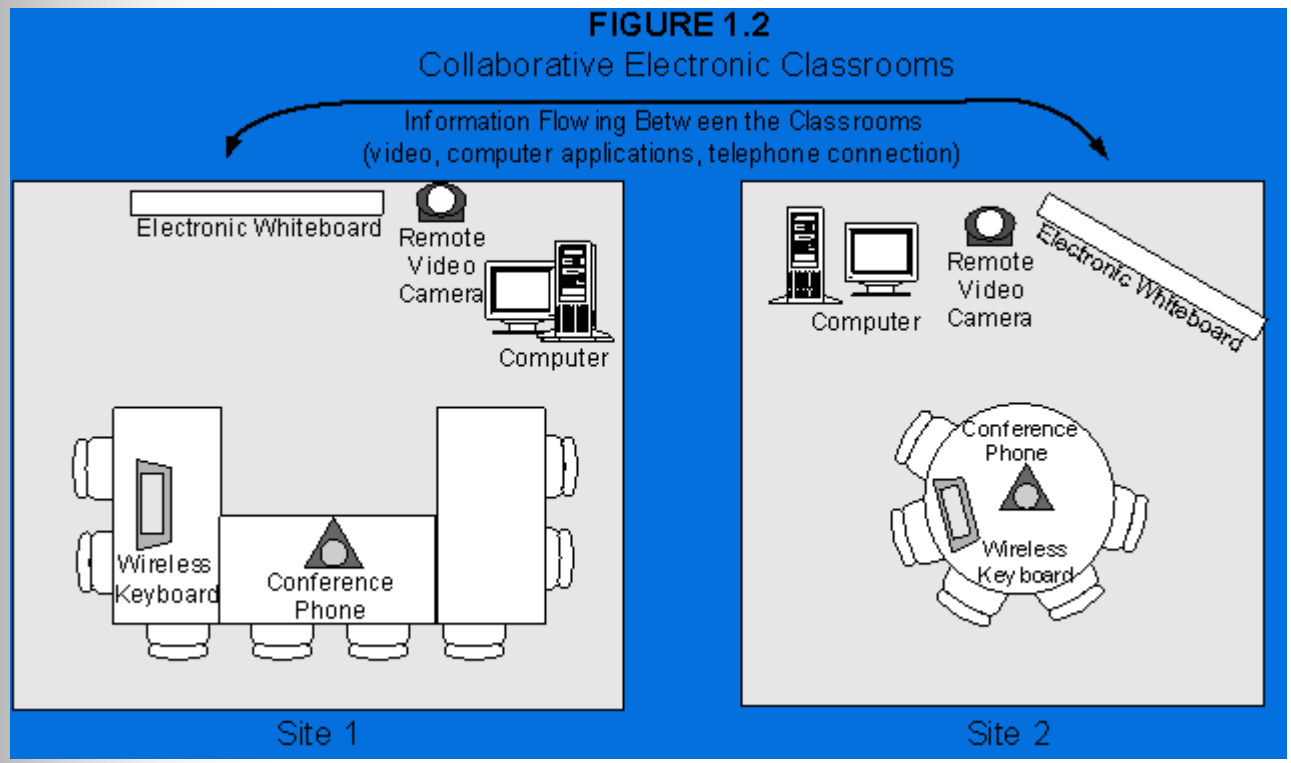
- Review on the current existing educational technologies applied to distance learning program and their pros and cons
- Some examples of ongoing distance learning projects
- The framework of our employed system
- Future plans

Overview of Supporting Technologies

Supporting Technologies	Levels of interactivity	Impact of Interactive qualities as reflected in learner response	Scale
Whiteboard, fax, web	Allow one-way (instructor to student) delivery of information (text and/or graphics)	Students interact with instructor and other students only when required	Few interactive qualities
Email, bulletin board, Chat room, conference phone	Allow two-way asynchronous and synchronous exchange of written information	About 25-50% students initiate interaction with the instructor and other students on a voluntary basis	Medium interactive qualities
Teleconferencing	Allow one-way visual and two-way voice communication between instructor and students	About 50-75% students initiate interaction with the instructor and other students on a voluntary basis	Above average interactive qualities
Real-time Video and Audio	Allow synchronous voice & visual communications between instructor and students and among students	Over 75% students initiate interaction with the instructor and other students on a voluntary basis	High interactive qualities

M. D. Roblyer, Leticia Ekhaml, "How Interactive are YOUR Distance Courses? A Rubric for Assessing Interaction in Distance Learning". Online Journal of Distance Learning Administration, Volume III, Number II, Spring 2000

A Typical Setting

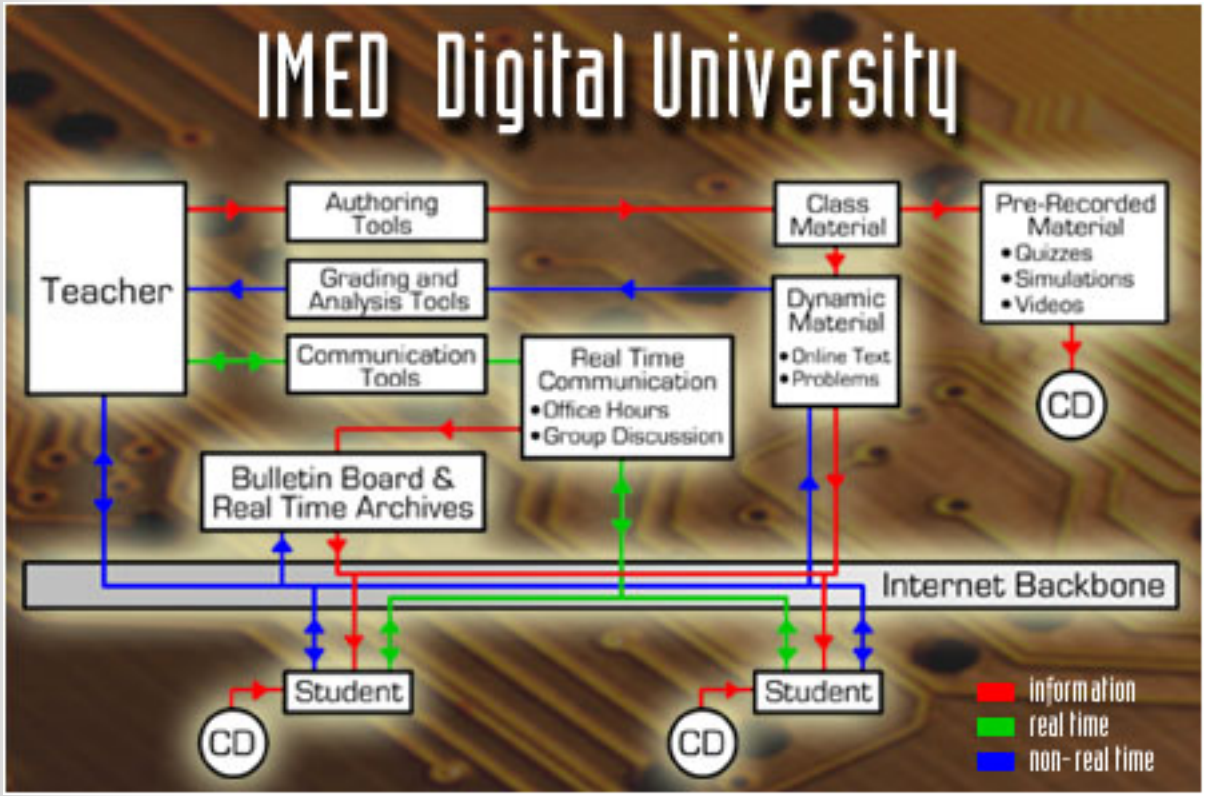




Japan, distance communication course

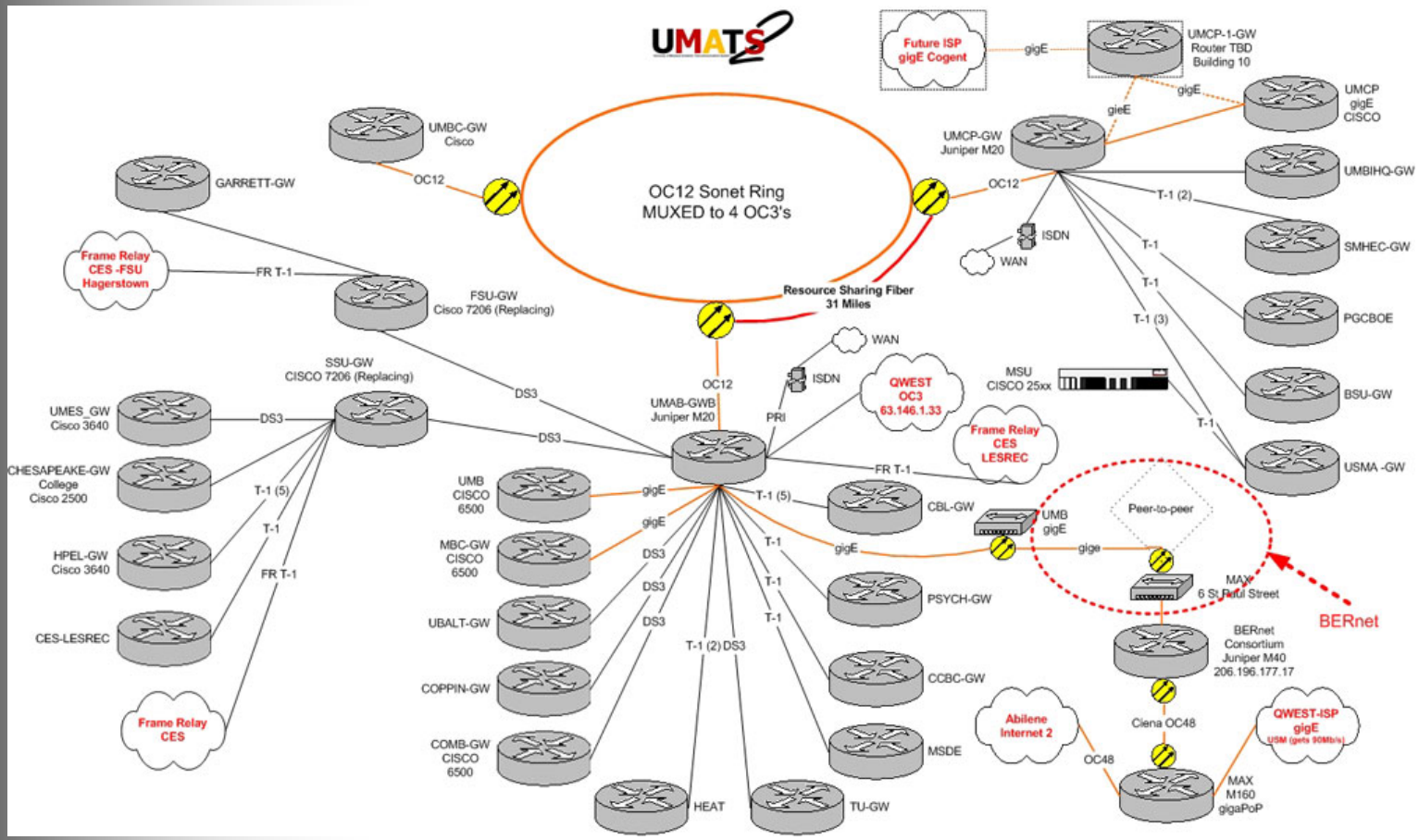

Maine Distance Learning project

UIC, Webboard, a conferencing system using a web-browser, is used for conferences and classes

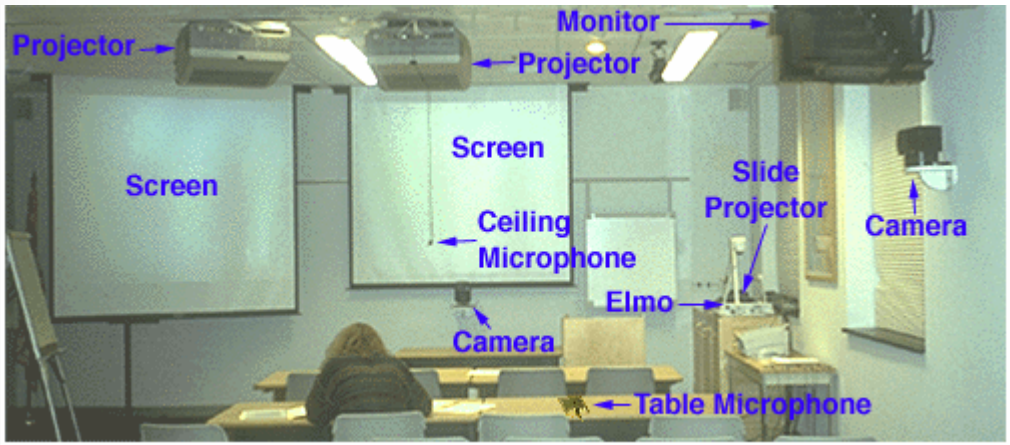


UCLA IMED (Interactive Multimedia Education at a Distance)

UCLA TIDE (Transpacific Interactive Distance Education)



A typical IVN site at UMATS (University of Maryland Academic Telecommunications System 2


Projector
Monitor
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Elmo
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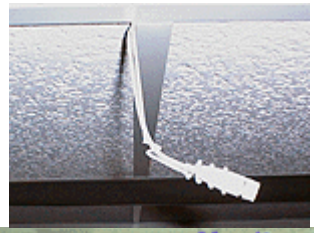
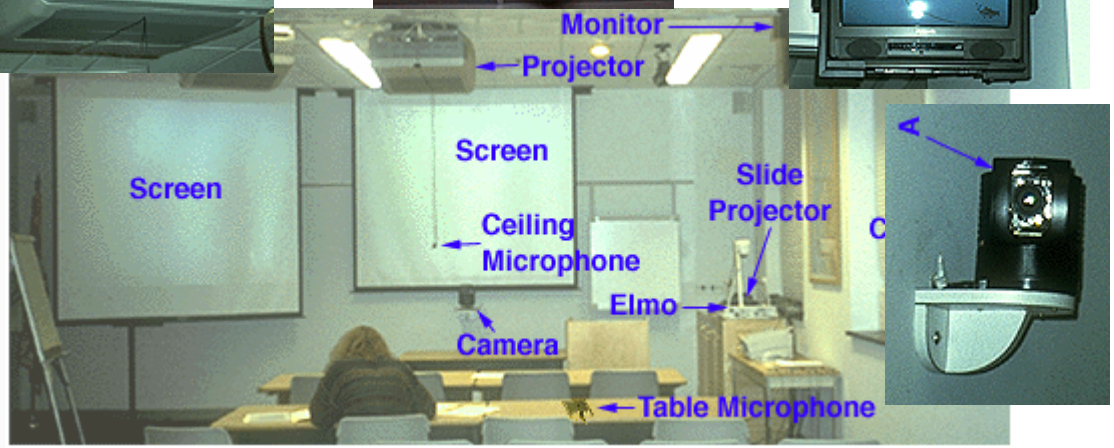
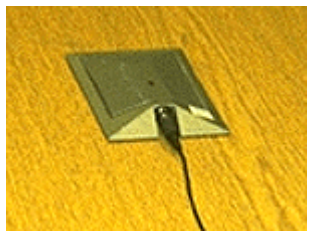
Table Microphone







Cameras | Elmo | Slide Projector | Microphone | Monitor | Projector & Screen

Mobile Interactive Classroom Distance Learning and Presentation System

ehb 01/21/99 *http://www.gti.net/ebrzez*

Equipment Required and Estimated Cost

$3,500 -- High end laptop with USB and LAN connections

$4,500 -- DLP XGA/SVGA Projector

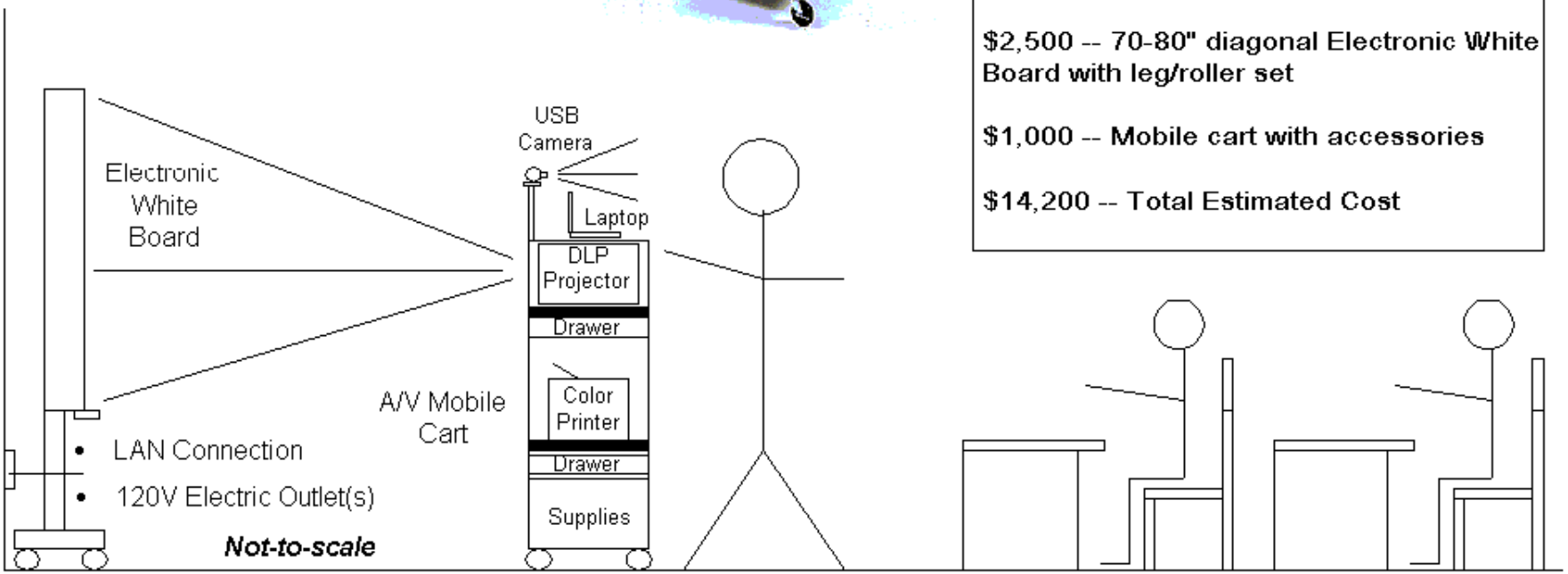
$2,500 -- Color Laser Printer

$ 200 -- USB Camera

$2,500 -- 70-80" diagonal Electronic White Board with leg/roller set

$1,000 -- Mobile cart with accessories

$14,200 -- Total Estimated Cost



Design of Our Employed System

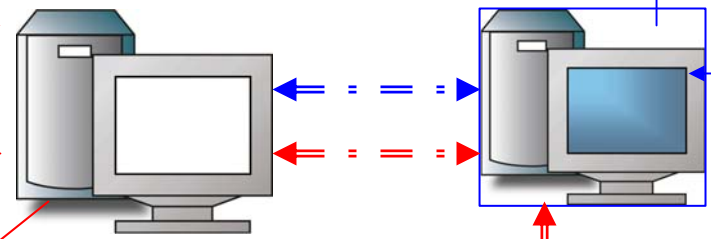
- Goal
- Components
  - Model
  - Real time video
  - Real time audio
  - Communication

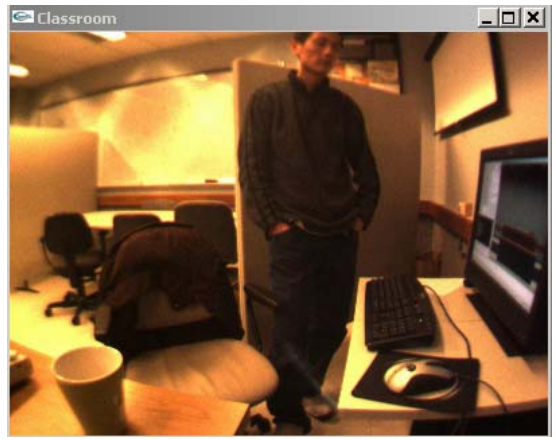
Goal

- Allow synchronous voice and visual communication between instructors and students and among students
- Introduce high interactive qualities and high level of visual realism

Layout

General Framework





Modeling and Rendering

- The classroom model was modeled using 3dstudio max, textured using photos real classroom photos.
- The 3D model is then exported as a max obj file to the classroom rendering engine.
- The rendered model is projected to the back of the physical classroom.

Model – 1st Version

Real classroom as reference to the model

Model – 1st Version

Rendered 3D model

Model – 2nd Version

Classroom Real Time Video Communication

- The local classroom is captured live by the flea camera at 800x600 and sent at 5 fps@400x300
- At the same time, populate the background subtracted sprites sent by the remote students in the virtual classroom to create the visual realism that those students sit in the virtual classroom

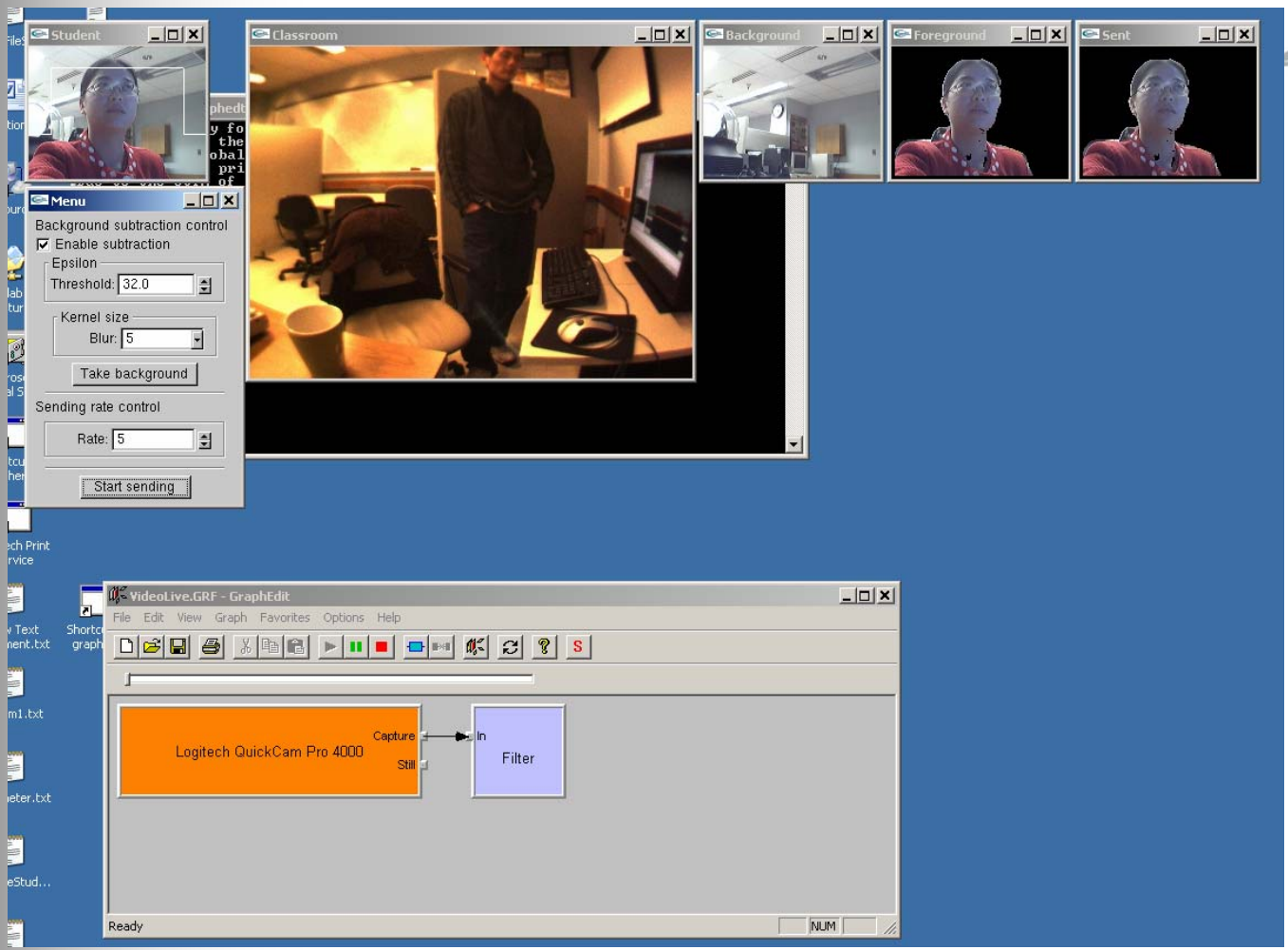
Student Real Time Video Communication

- Capture video from a consumer webcam and display it.
- Display the background subtracted image and send it to the local classroom.
- Receive the classroom video from the local classroom and display it.
- Both the classroom video and the student video are sent across the network in compressed form.

Real Time Audio Communication

- The same audio program is used in all locations, both in the local classroom and in the remote sites.
- The students wears headsets to send and receive the voice. The instructor speaks through lavaliere mike and captures the voice from the speaker.

Display in local classroom



Display at remote student site

Network Communication

- Use spread toolkit as the message bus to send and receive video and audio messages across the network.
  - Messages sent reliably in a multicast network.
  - Messages sent and received via groups, guarantee safety.
    - Remote student sites and the local classroom join groups to send/receive the video sprites and audio messages.

Problems Addressed

- Windows TCP/IP slows down the message passing.
  - Solutions:
    - Reside the SPREAD server in each site to speed up the transmission.
    - Increase the server buffer size to hold up more messages in queue.
    - Send out more messages when holding the sending rights.
    - Send video messages in compressed form (MPED).

Experiments

Configuration	Number of fisheye cameras	Fisheye frame width (pix)	Fisheye frame height (pix)	Fisheye frame rate (fps)	Fisheye bandwidth (bits/s)	Number of webcams	Webcam frame width (pix)	Webcam frame height (pix)
A	1	800	600	2	30,720,000	5	320	240
B	1	800	600	2	30,720,000	5	320	240
C	1	800	600	2	30,720,000	5	160	120
D	1	800	600	2	30,720,000	5	160	120
E	1	400	300	5	19,200,000	5	160	120
F	1	400	300	3	11,520,000	5	160	120
G	1	400	300	2	7,680,000	5	160	120
H	1	200	150	1	960,000	5	160	120
I	1	400	300	2	7,680,000	5	160	120
J	1	200	150	2	1,920,000	4	160	120
K	1	100	75	2	480,000	5	80	60
L	0	100	75	1	0	0	80	60
M	1	100	75	2	480,000	5	80	60
K'	1	100	75	2	480,000	5	80	60
M'	1	100	75	2	480,000	4	80	60
N	1	200	150	2	1,920,000	4	160	120
P	1	200	150	5	4,800,000	4	160	120
Q	1	400	300	5	19,200,000	5	160	120

Experiments

Webcam frame rate (fps)	Webcams bandwidth (bits/s)	Audio memory cost (bits/s)	Number of audio sources	Audio bandwidth (bits/s)	TOTAL bandwidth (bits/s)	TOTAL sending bandwidth of local classroom(bits/s)	TOTAL sending bandwidth of each student(bits/s)
5	61,440,000	1,411,200	6	8,467,200	100,627,200	32,131,200	13,699,200
3	36,864,000	1,411,200	6	8,467,200	76,051,200	32,131,200	8,784,000
5	15,360,000	1,411,200	6	8,467,200	54,547,200	32,131,200	4,483,200
3	9,216,000	1,411,200	6	8,467,200	48,403,200	32,131,200	3,254,400
5	15,360,000	1,411,200	6	8,467,200	43,027,200	20,611,200	4,483,200
3	9,216,000	1,411,200	0	0	20,736,000	11,520,000	3,254,400
5	15,360,000	1,411,200	0	0	23,040,000	7,680,000	4,483,200
1	3,072,000	1,411,200	0	0	4,032,000	960,000	2,025,600
5	15,360,000	1,411,200	6	8,467,200	31,507,200	9,091,200	4,483,200
2	4,915,200	1,411,200	0	0	6,835,200	1,920,000	1,228,800
1	768,000	1,411,200	0	0	1,248,000	480,000	153,600
1	0	1,411,200	6	8,467,200	8,467,200	1,411,200	1,564,800
1	768,000	1,411,200	6	8,467,200	9,715,200	1,891,200	1,564,800
5	3,840,000	1,411,200	0	0	4,320,000	480,000	2,179,200
1	614,400	1,411,200	5	7,056,000	8,150,400	1,891,200	1,564,800
1	2,457,600	1,411,200	5	7,056,000	11,433,600	3,331,200	2,025,600
5	12,288,000	1,411,200	5	7,056,000	24,144,000	6,211,200	4,483,200
5	15,360,000	1,411,200	6	8,467,200	43,027,200	20,611,200	4,483,200

Experiments

- Travel time between local classroom and 5 students sites
  - Video
    - Maximum 1 second, 0.5 second on average.
  - Audio
    - Maximum 1 second, 0.5 second on average.

Future Plan

- Instructor’s face tracking
- Audio white noise self recognition
- Achieve high bandwidth on windows
- Linux platform
- WAN communication

Project Teams

- Supervisor
  - Voicu Popescu, Cristina Nita-Rotaru, Laura Arns, Gary Bertoline
- Modeling
  - Ed Carpenter, Carlos Morales
- Rendering
  - Chun Jia, Win Mar Htay, Radu Dondera
- Network Communication
  - Chun Jia, Win Mar Htay, Radu Dondera, Ajith Kumar
- Evaluation
  - Dazhi Yang, Cindy York