Distributed collaborative systems and interaction: Project C2C

Zdeněk Trávníček[1,2]

[1]Institut Intermédií
[2]Katedra Počítačové Grafiky a Interakce
České Vysoké Učení Technické v Praze

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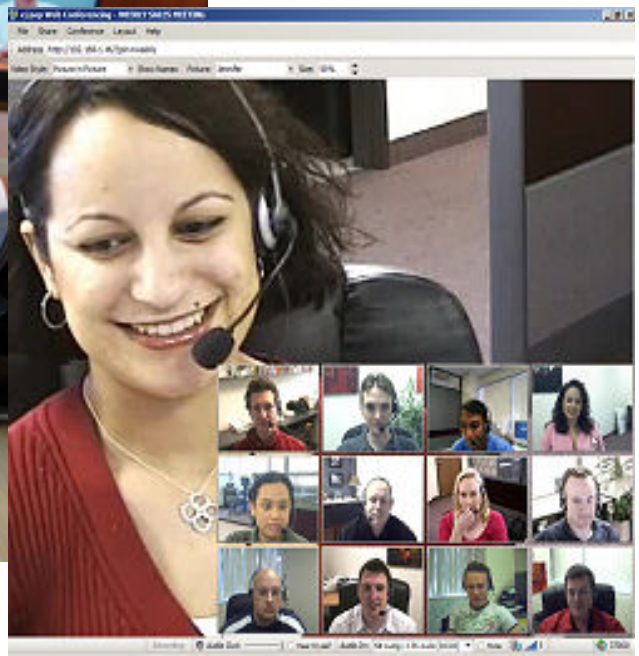
What is a collaborative system?

Multiplayer games

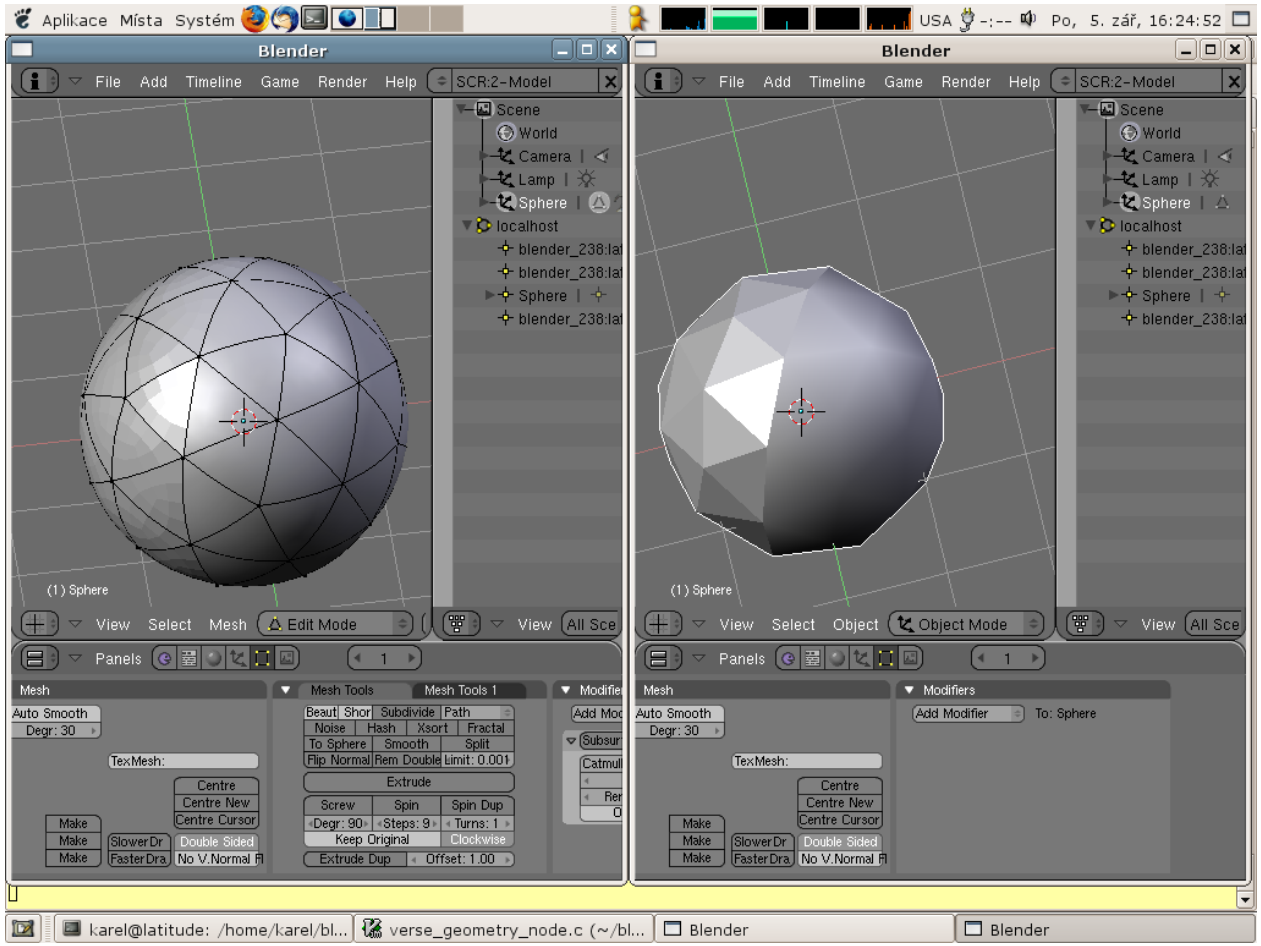
Military simulations

Collaborative Virtual Environments (CVE)

Teleconferencing



Working on shared geometry



What is a collaborative system?

- Collaborative Virtual Environments (**CVE**)
  - Virtual world/worlds
  - Domain specific vs general
  - Multicast vs P2P
- Audio/video transmissions
- 3D geometry
- Arbitrary data
- **Multiple users**
- **Interaction**

Distributed Interactive Simulation

- University of Central Florida, IST
- Based on SIMNET
- 12 entity families
- versions 1-6 (1992-1998)
- version 7 scheduled for spring 2009
- UDP
- Dead reckoning
- HLA - advanced simulation protocol

Entities

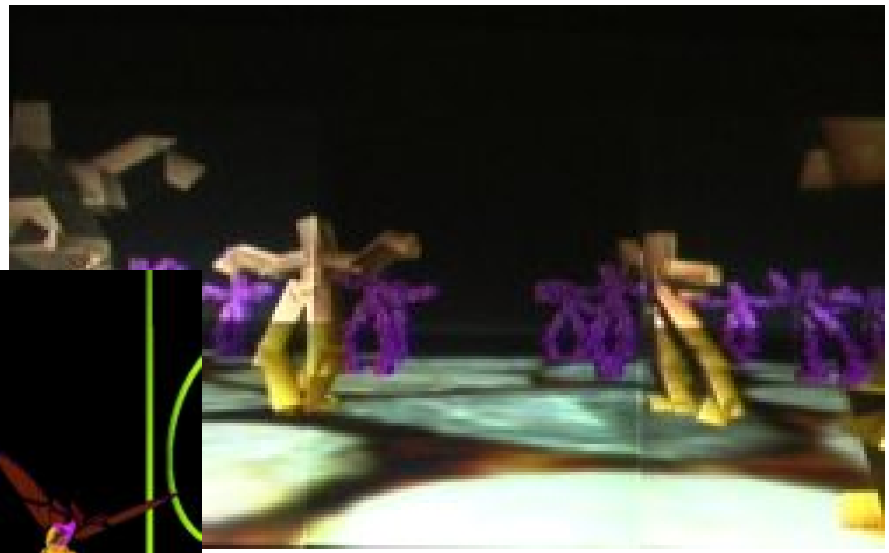
- Entity information family
- Warfare family
- Logistics family
- Simulation management family
- Distributed emission regeneration family
- Radio communications family
- Entity management family
- Minefield family
- Synthetic environment family
- Simulation management with reliability family
- Live entity family
- Non-real time family

NPSNET

- DIS compatible NPSNET-IV (C++)
- Multi-platform multi-lingual Bamboo project
- Java-based **NPSNET-V**
- **EntityMaster** x **EntityGhost**
- Automatic entity loading
- Automatic selection of network protocol
- LDAP for locating components

Myriad shared scene graph

- University of Illinois at Urbana Champaign
- Primary used in syzygy framework
- P2P network to filter updates
- Optimized for CVE over WAN
- Self-regulating feedback system
- RPC



Verse

- "Lightweight, low latency, general-purpose network protocol for 3D data"
- Uni-verse project
- Supported in Blender (J. Hnidek), GIMP
- Bandwidth effective

CoUniverse - **Co**llaborative **Universe**

- MUNI - Sitola
- Self-organization collaborative environment
- Incorporation/encapsulation of external tools
- Adaptation to changing conditions
- High-bandwidth streams
- Network state visualization
- Collaborative universe, multiverse

Cave2Cave

Involved people/laboratories

Cesnet - Aktivita 616 Jiří Navrátil

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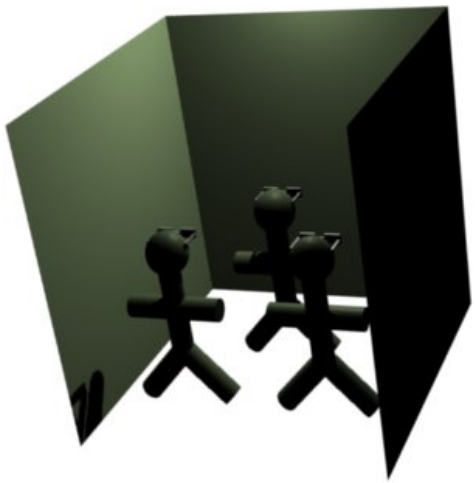
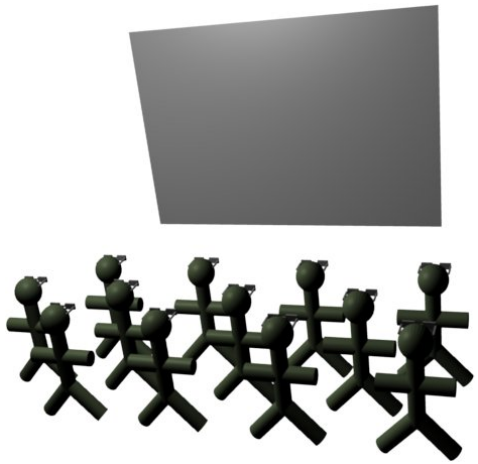
KPGI - VRLab	Vlastimil Havran, Jiří Bittner, Jiří Žára, Pavel Slavík





Motivation

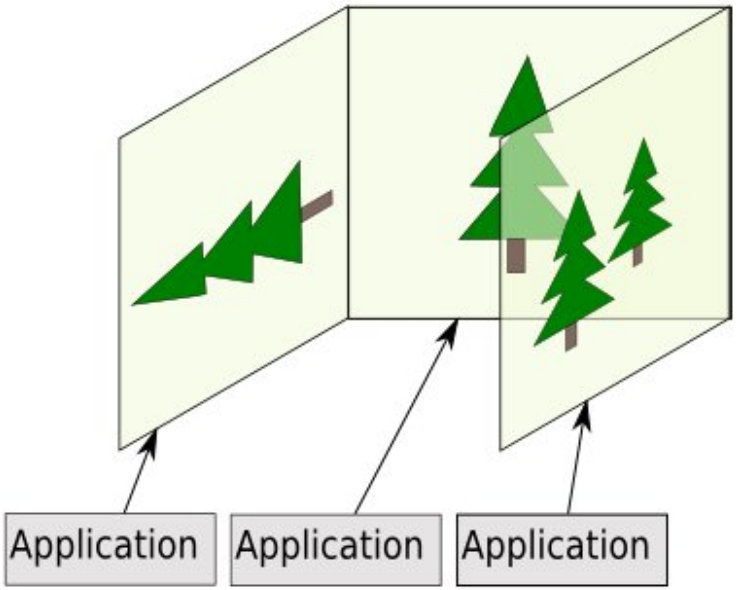
- Connect (two) VR devices
- Versatility
  - Video-based approach
  - Application independent
  - Supports virtually any OpenGL application
- Heterogeneous systems

Phase 1 Remote presentation

Phase 2 Interaction

Phase 3 Collaboration

Wrapper



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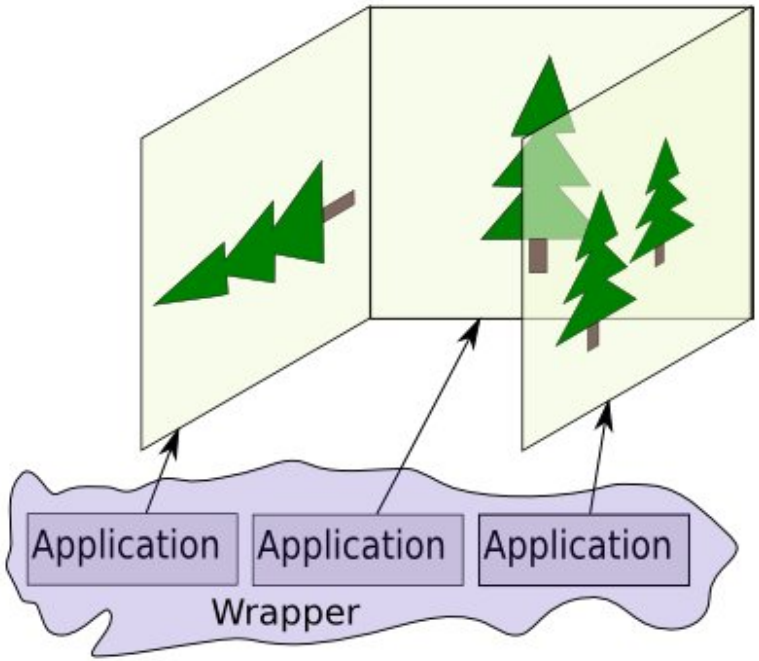

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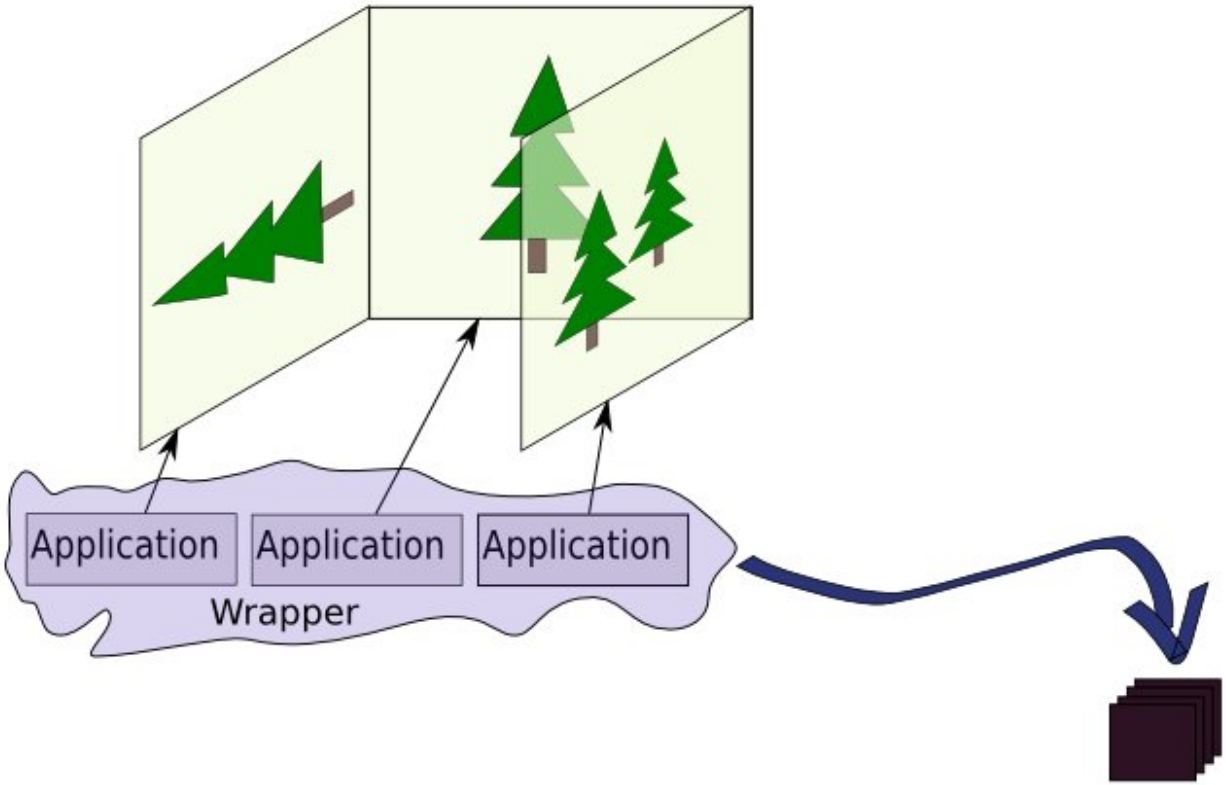

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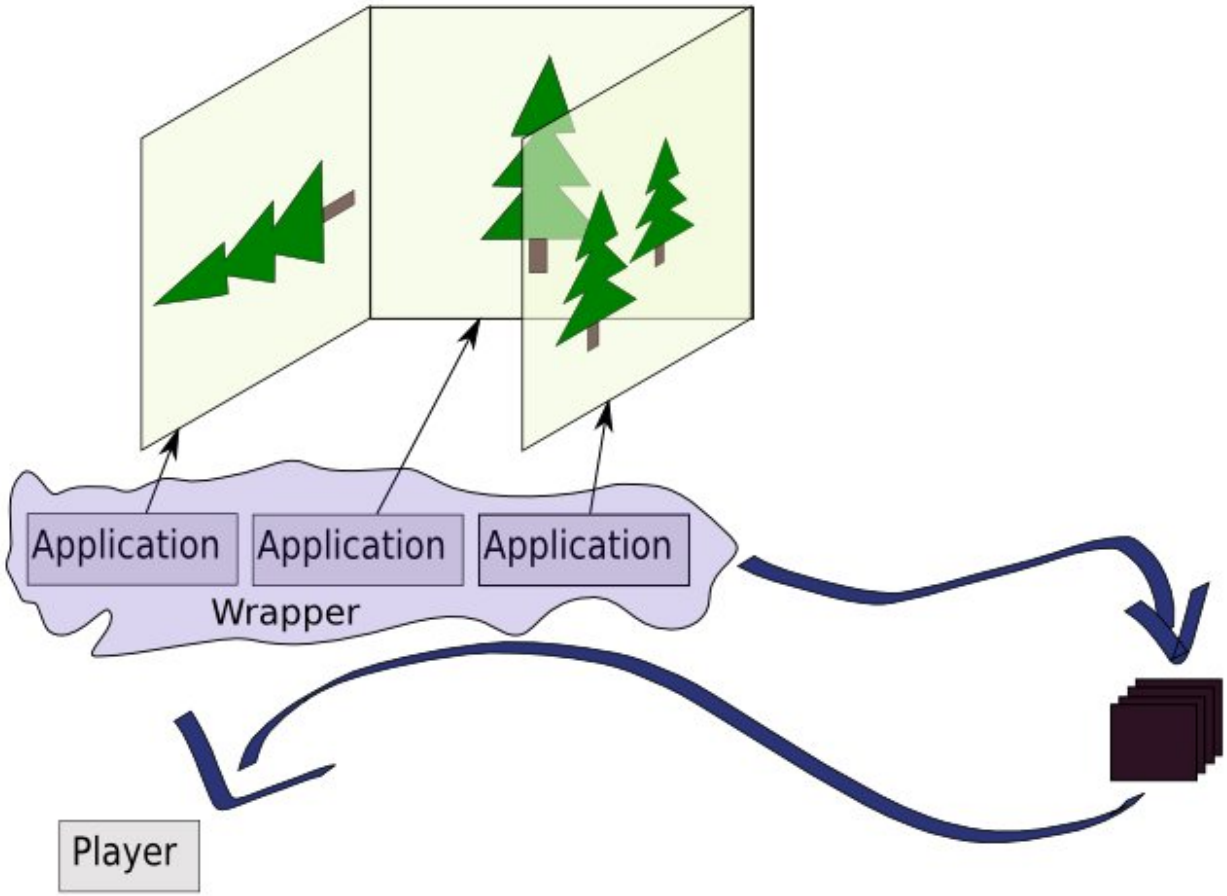

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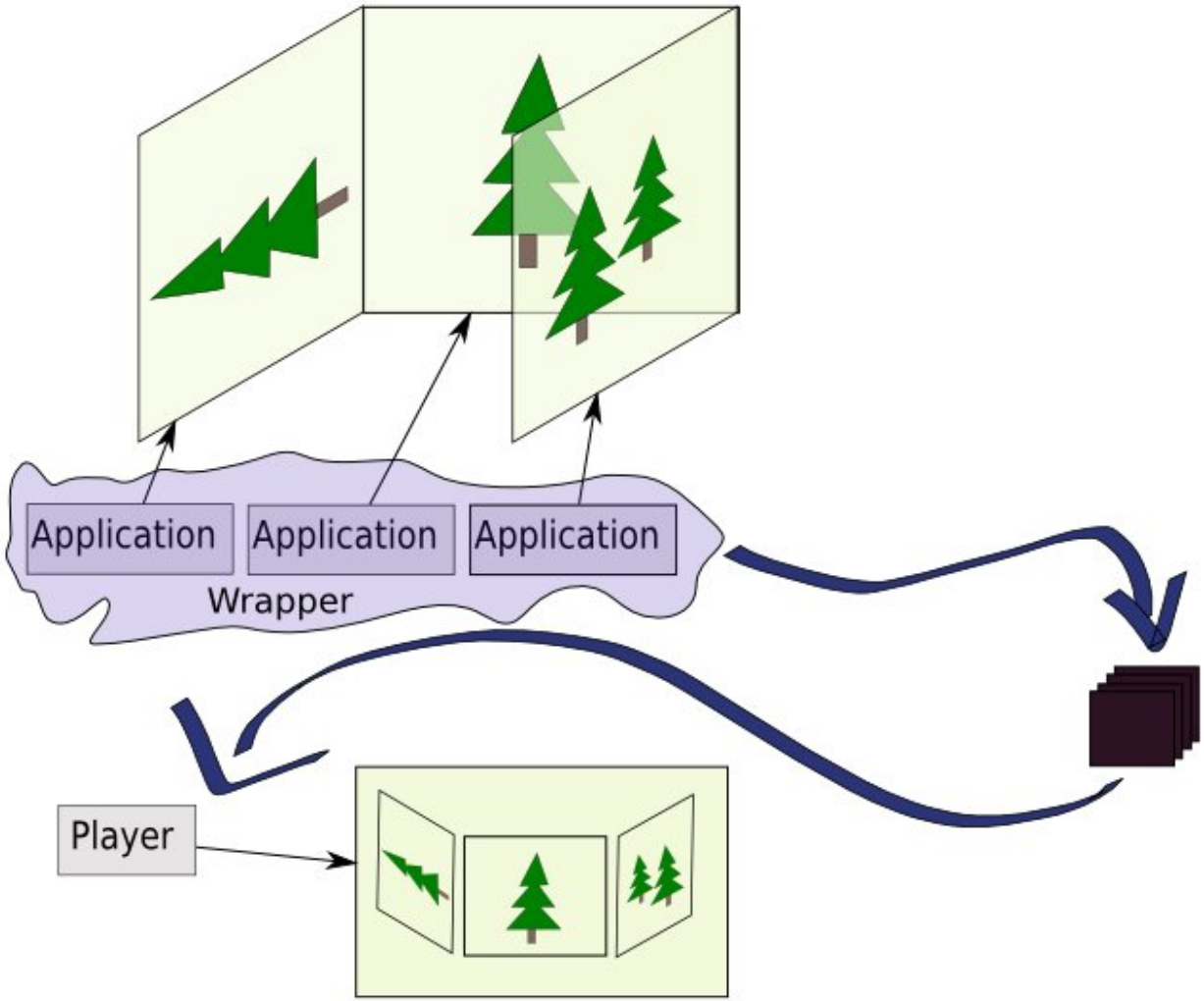


Wrapper (2)

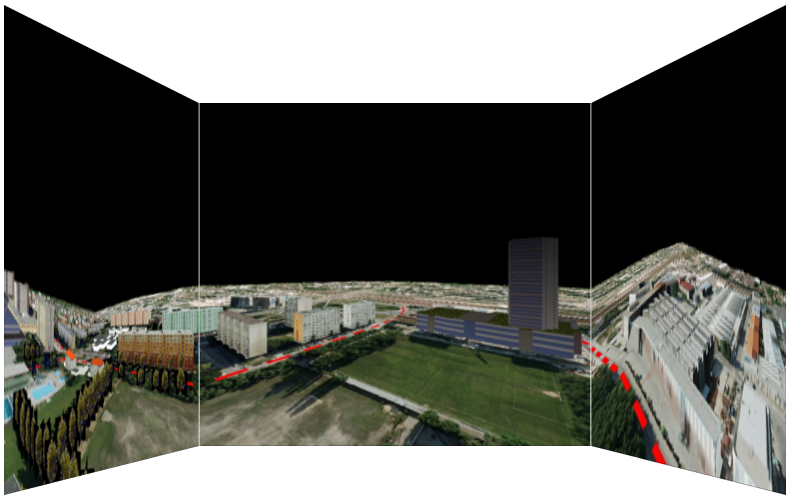
- Preloaded by dynamic loader
- Transparent for application
- Multithreaded
- Hooks on glViewport
  - Detects resolution
- Hooks on SwapBuffers (GLX,SDL)
  - Grabs frame buffer and sends to other thread for processing

Features of current implementation

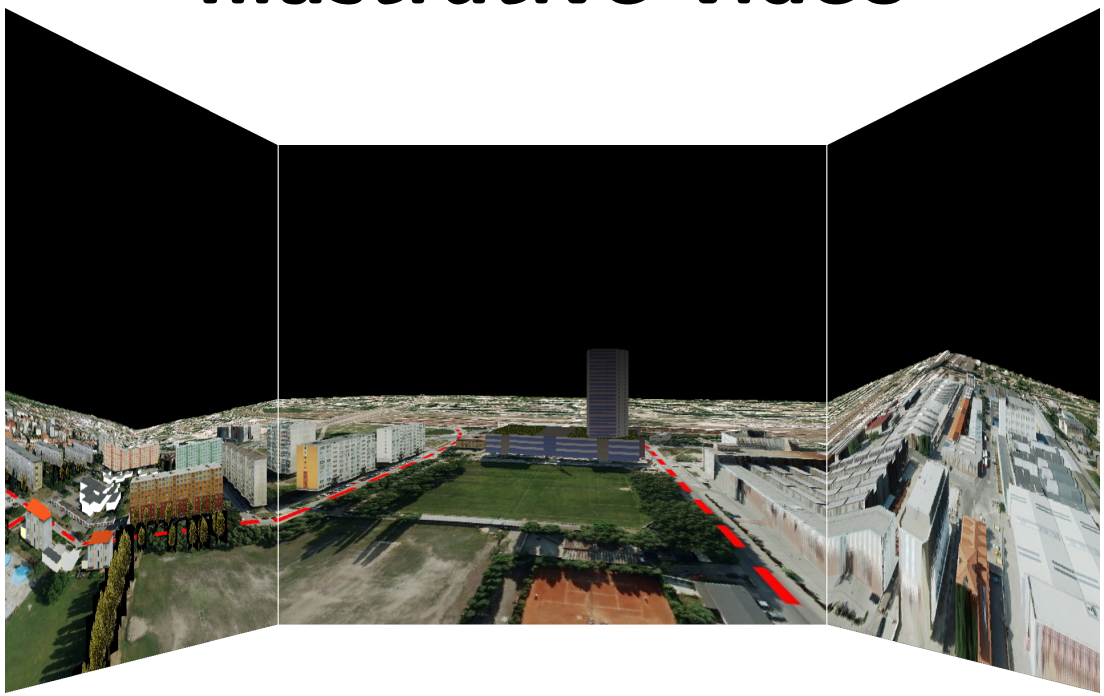
- Grabbing from frame buffer - synchronously/on background
- Scaling of output stream to arbitraty resolution
- Streaming to multicast using RTP
  - Raw video (RFC4175)
  - MPEG1/2
- Implements RTSP server
- Frame rate limiting
- **Grabbing from stereo buffers**

Client application - player

- Receives arbitrary number of RFC4175 compliant RTP streams
- Separate display modes for CAVE-like input and other
- Handles packet loss
- Configurable
- Interaction
  - Hardware solution
  - Virtual event device



Illustrative video



Mid-term/Long-term plans

- Mid-term plans
  - Adding live video
  - Incorporating user input
  - Streaming on demand
  - Classes of equivalence
- Long-term plans
  - Adding other streams (audio, 3D data, tracking info, ...)
  - Creating robust system for collaboration

Questions?