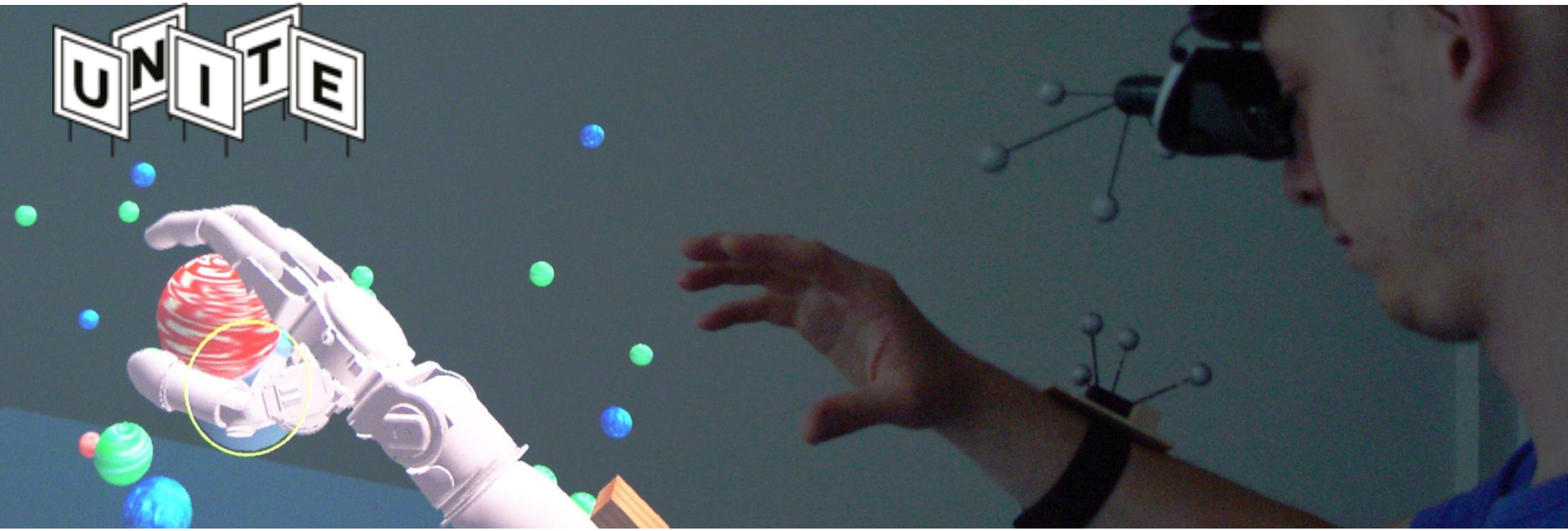

Virtual Reality Training for Upper Limb Prosthesis Patients

Annette Mossel

Interactive Media Systems Group
Software Technology & Interactive Systems
Vienna University of Technology

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Motivation

- Myoelectric Prostheses

Muscle Contraction (Myoelectric Impulses)

⇩

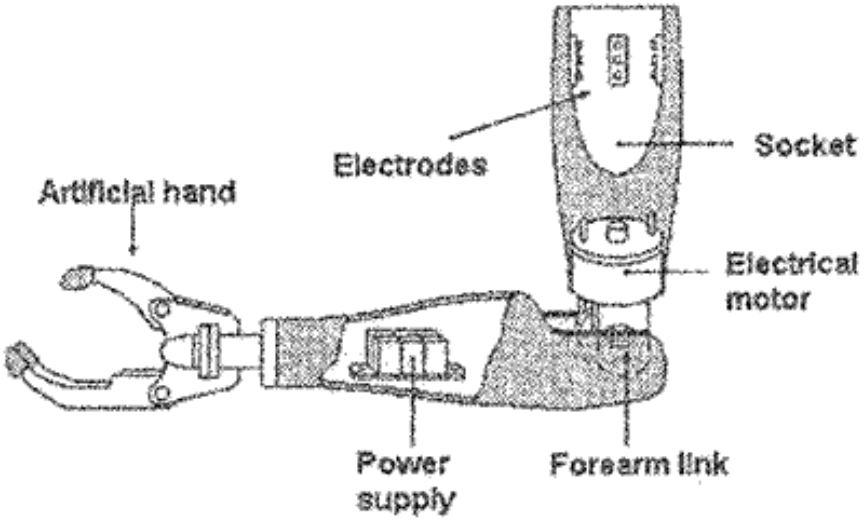
BioSensors (Electrodes)

⇩

Motor

⇩

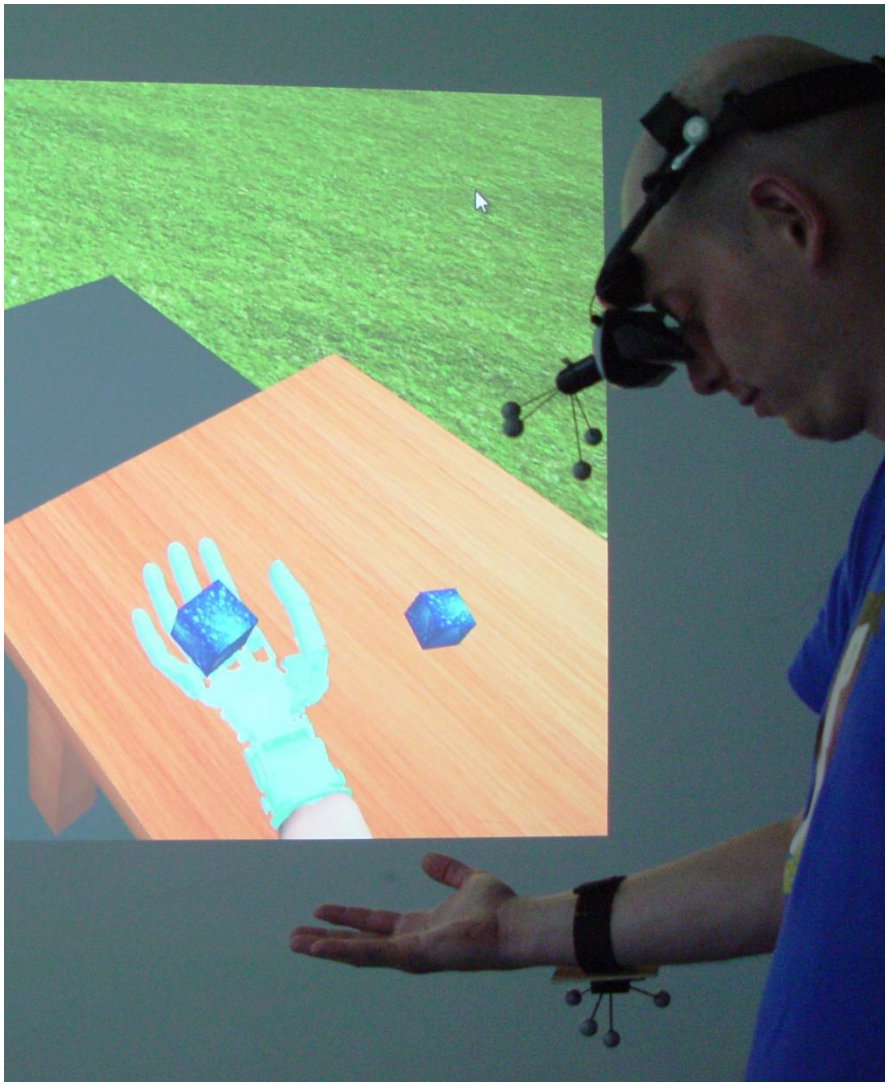
Grasping of Artificial Hand



- Arm prosthesis must be individually fitted to amputee
  - Frustrating experience for patient
  - Impairs learning of prosthesis control at early stage
  - Consumes time (and money) in manufacturing process

Idea & Aims

- Provide training to continuously motivate amputee to practice control skills of prosthesis without taking risks
- Provide measurements to give feedback to manufacturer already during manufacturing process for optimal customization
- Save time for patient
- Save time & money for manufacturer



Requirements

- Real-time tracking
  - of HMD to provide ego view on scene for better learning
  - of arm target to control virtual prosthesis

Virtual Reality with Unity3D offer solutions for all requirements.

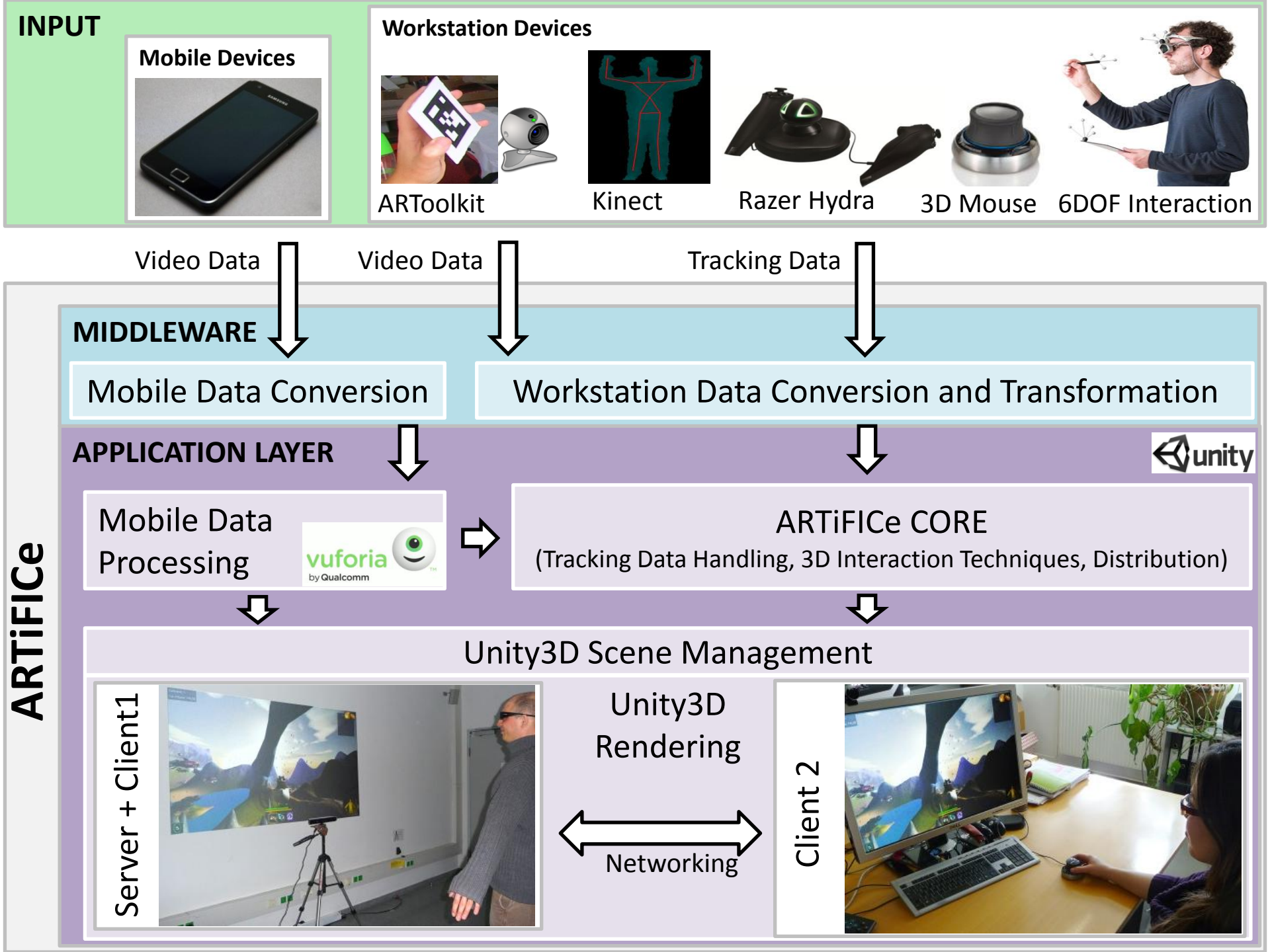
- Real time rendering of virtual scene
- Allow physical interaction with virtual scene
- Provide serious game to enhance patient's motivation

Augmented Reality Framework for Distributed Collaboration

ARTIFICE

www.ims.tuwien.ac.at

Mossel, A., Schoenauer, C., Gerstweiler, G., Kaufmann, H.: *ARTiFICe - Augmented Reality Framework for Distributed Collaboration*
presented at IEEE Virtual Reality Workshop on Off-The-Shelf Virtual Reality, Orange County, USA, 2012
to appear in International Journal of Virtual Reality (2012)


INPUT
Mobile Devices
Workstation Devices
ARToolkit
Kinect
Razer Hydra
3D Mouse
6DOF Interaction
Video Data
Video Data
Tracking Data
ARTiFICe
MIDDLEWARE
Mobile Data Conversion
Workstation Data Conversion and Transformation
APPLICATION LAYER
unity
Mobile Data Processing
vuforia
by Qualcomm
ARTiFICe CORE
(Tracking Data Handling, 3D Interaction Techniques, Distribution)
Unity3D Scene Management
Server + Client1
Unity3D Rendering
Networking
Client 2

Virtual ArmProsthesis Trainer

MyoSensors
Detect muscle contraction to control grasping of virtual prosthesis hand

MyoSensor Data

ArmTarget
Control position& orientation of virtual prosthesis

Head Mounted Display (HMD)
Display ego-perspective of virtual scene to the user

iotracker

3D Position and Orientation of HMD & Arm Target

Optical Tracking Data

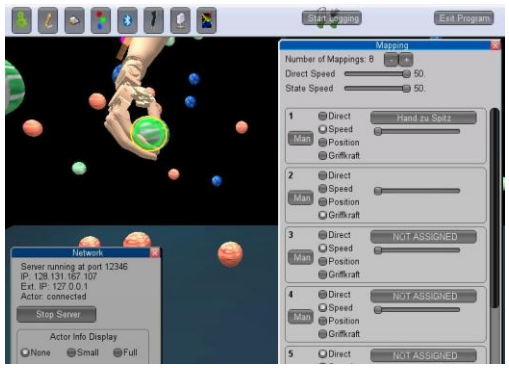
ARTiFiCe

unity

TrackingData Conversion & Fusion → Data Distribution

Unity3D Scene Management

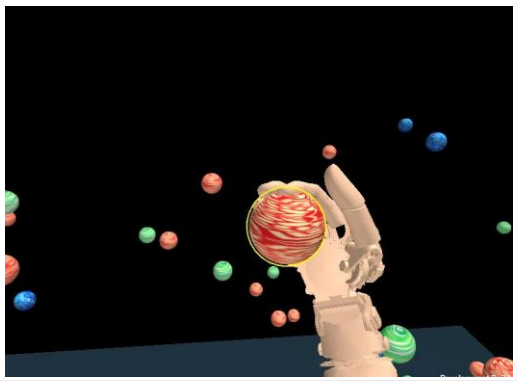
AdminView (Server)



Unity3D Rendering

Networking

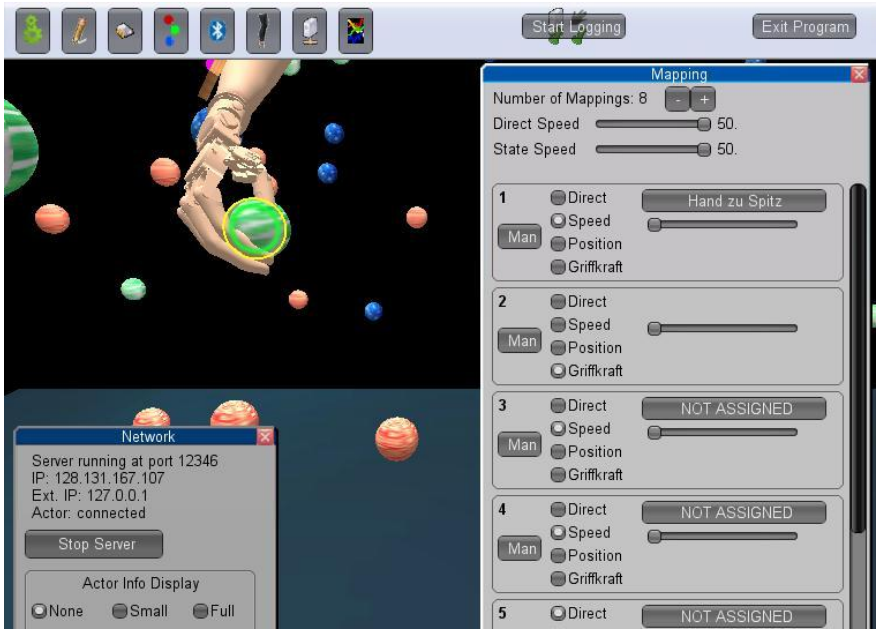
UserView (Client)



Server-Client Architecture

Server
(Admin View on Desktop PC)

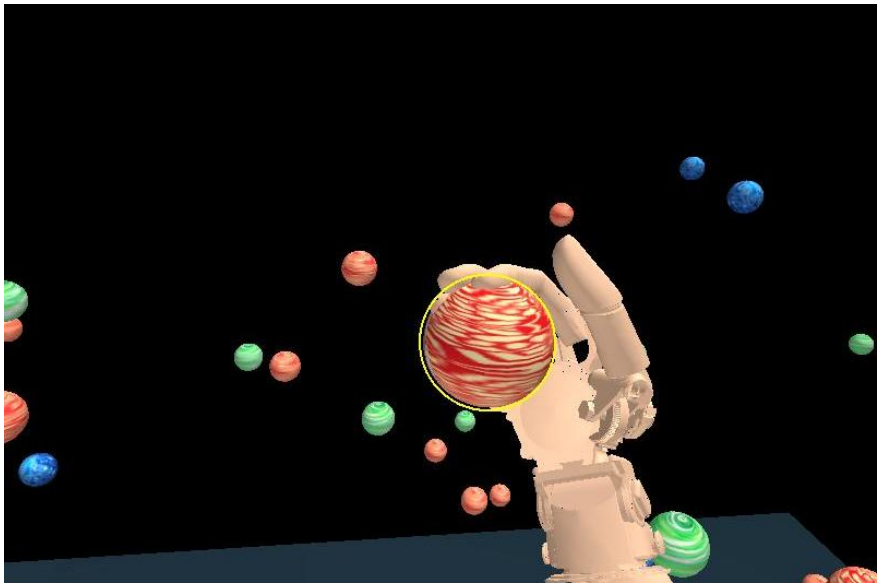
- Controls application and logs user input
- Parameters can be set for
  - Connection
  - Visualization
  - Style and speed of hand grasping



TCP/IP Networking

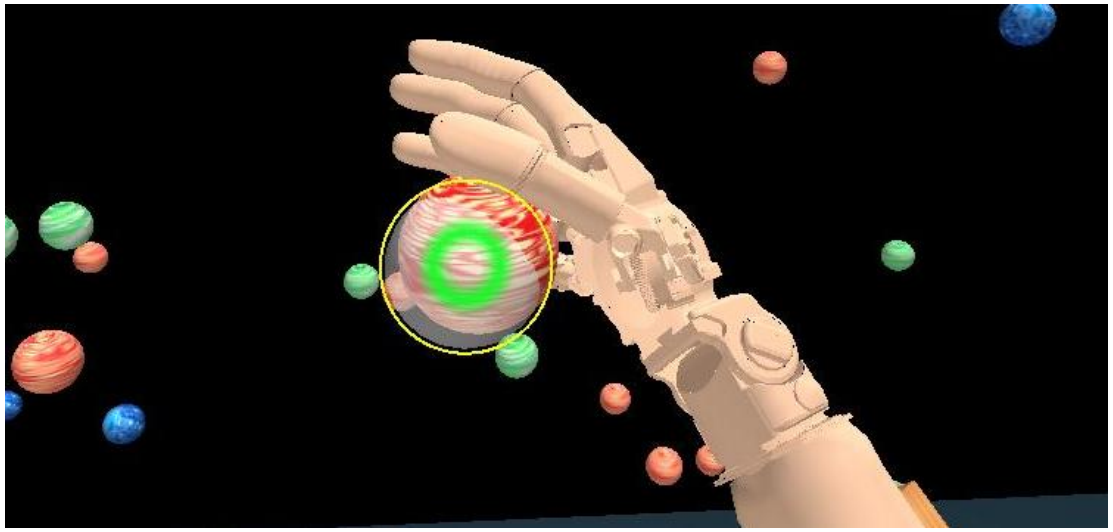
Client
(User View in HMD)

- Visualize virtual game environment in user's HMD
- Map real motion of user's ArmTarget is to virtual prosthesis
- Transform signals of MyoSensors to open/close and adjust grasp force of prosthesis hand



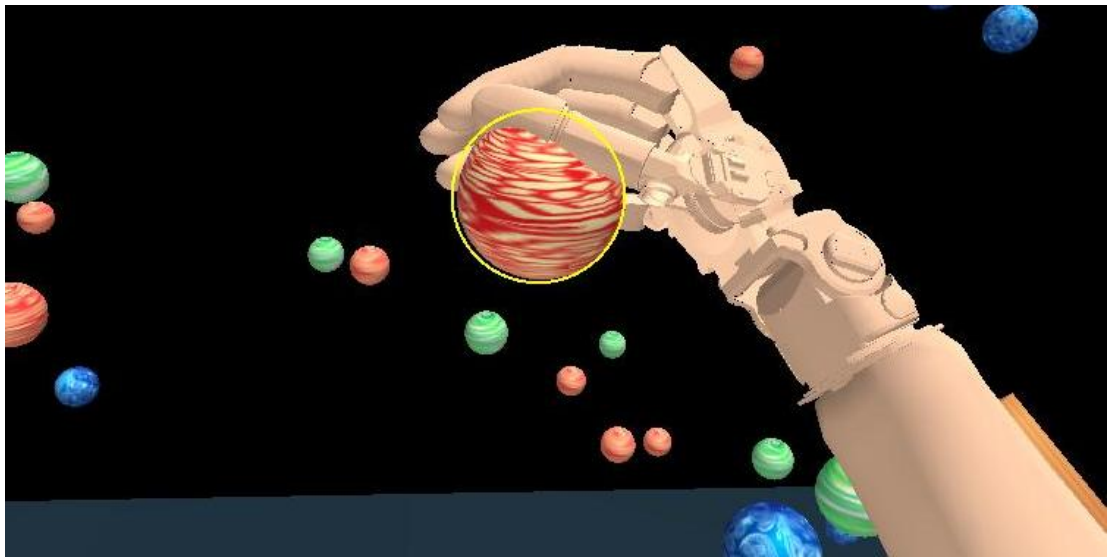
Two Training Scenarios

Serious Game 2 - Example



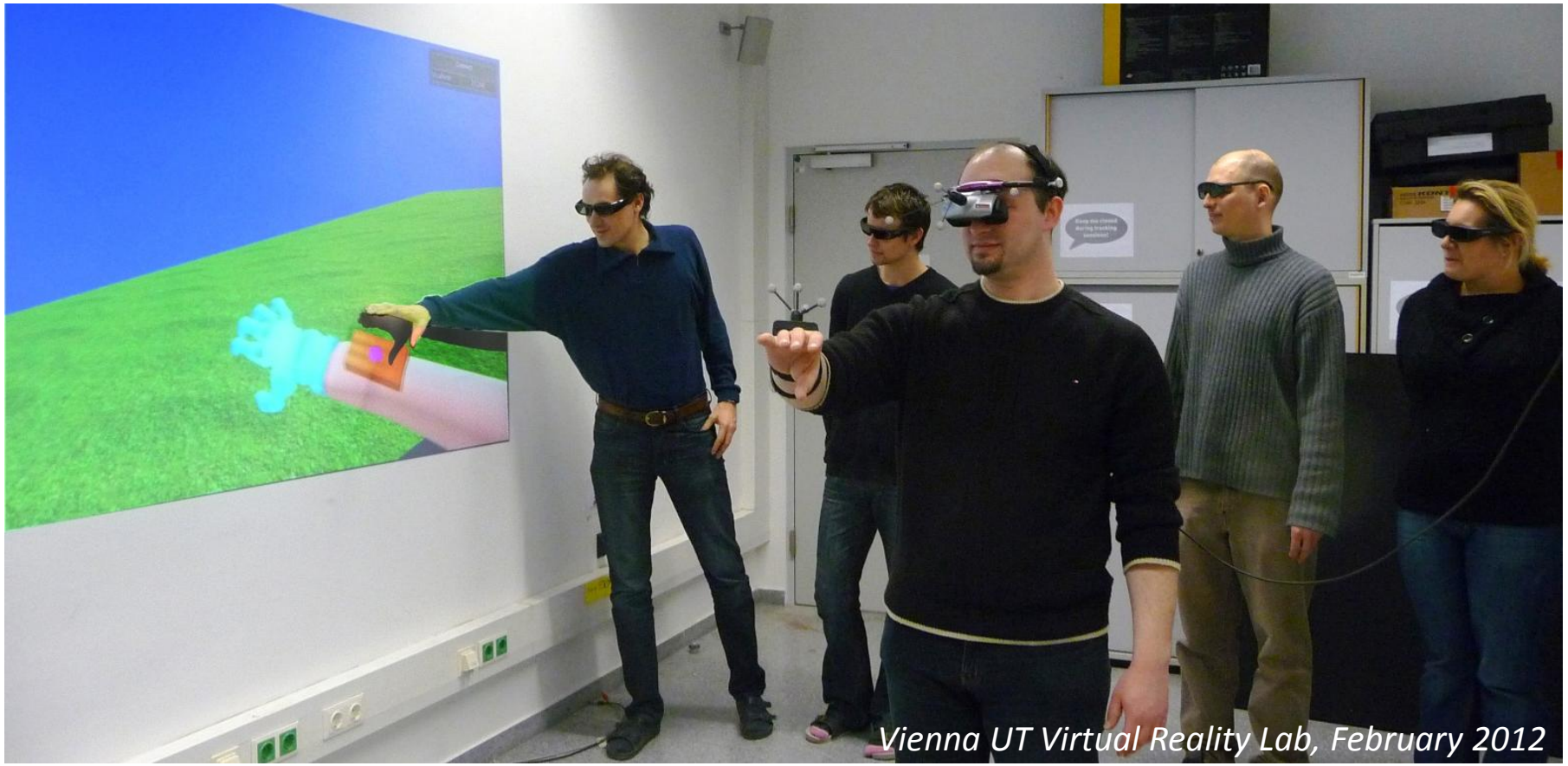
Step 1:
Aim virtual hand at object with ArmTarget until hand and sphere are aligned (yellow circle).

Then adjust force (green circle) with MyoSensors



Step 2:
Close virtual hand with MyoSensors, then move grasped object with ArmTarget to target area.

Demonstration Setup @ Vienna UT

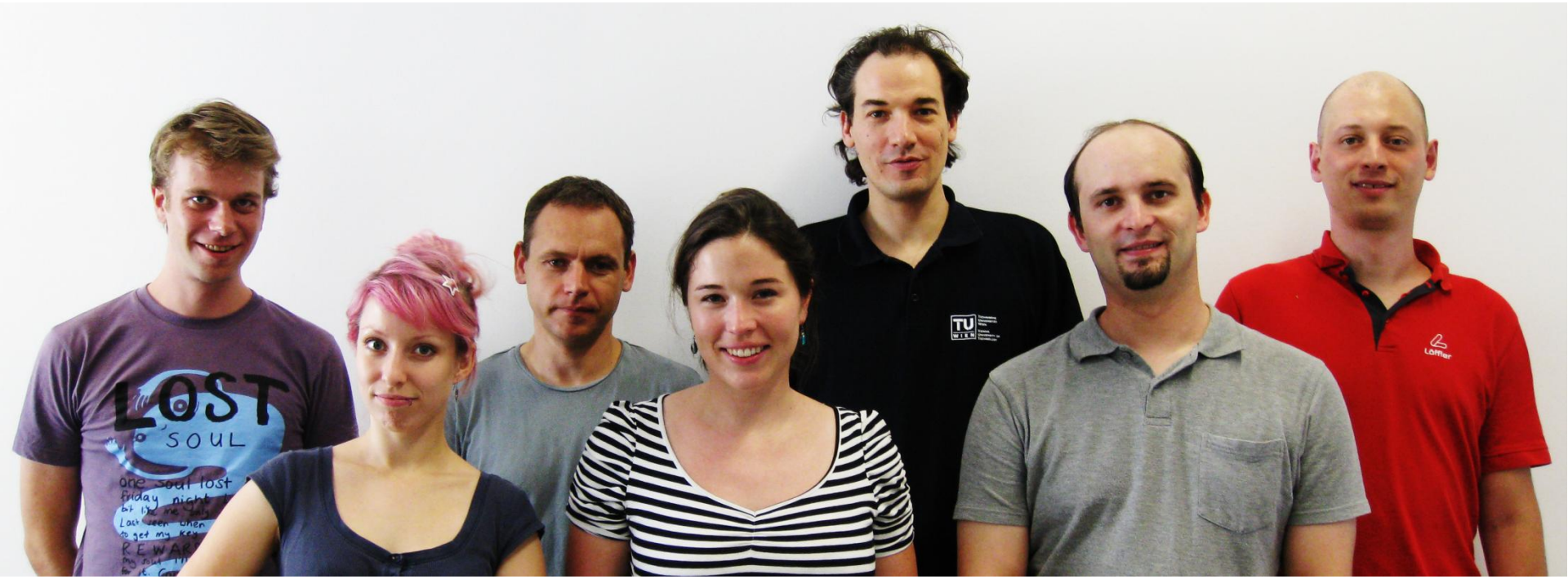


- ArmTarget with MyoSensors for user interaction and training
- HMD for ego perspective rendering of virtual scene
- Stereo projection of HMD-view for group view

Results

VIDEO

Acknowledgements



Prof. Dr. Hannes Kaufmann (Project Leader)
Michael Bressler (Development)
Christian Schönauer (Infrastructure)

Interactive Media Systems Group
Software Technology & Interactive Systems
Vienna University of Technology

Andrei Ninu (Development)

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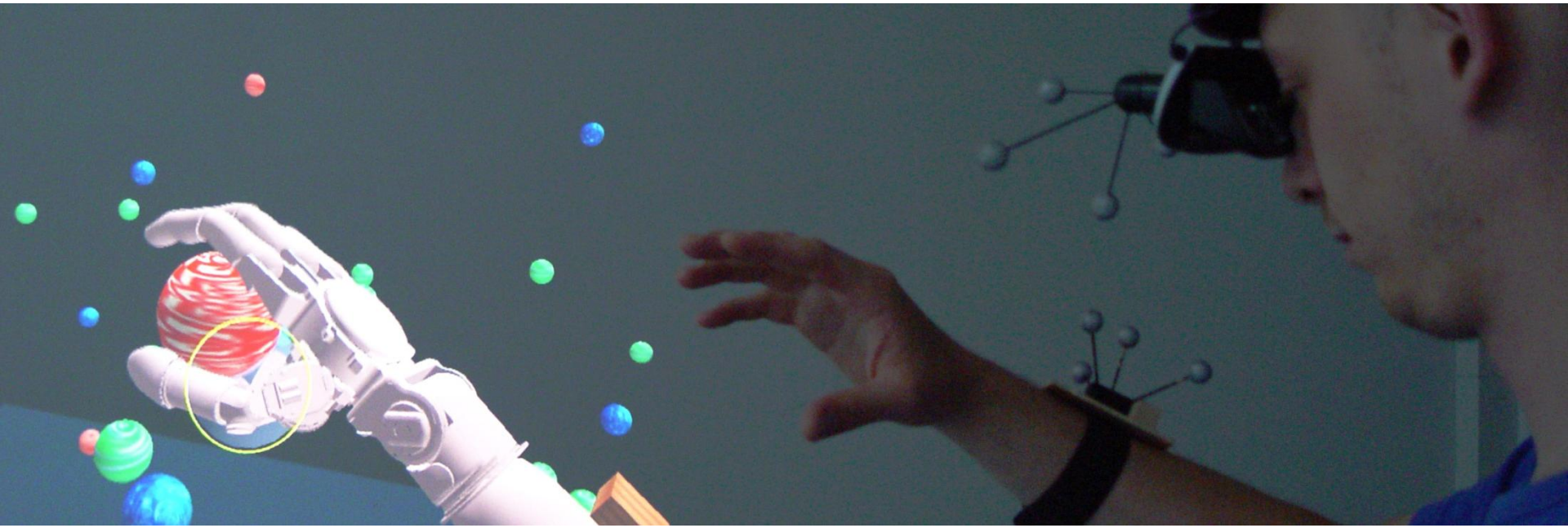
Conclusion

- Provide motivating immersive training with ARTiFiCe & Unity
- Enhance production process & customization of prosthesis
- Future Work:
  - Testing with patients in General Hospital Vienna (Otto Bock)
  - Development of more entertaining Serious Game (TU Wien)



Hannes Kaufmann, *kaufmann@ims.tuwien.ac.at* | Annette Mossel, *mossel@ims.tuwien.ac.at*
http://www.ims.tuwien.ac.at

References

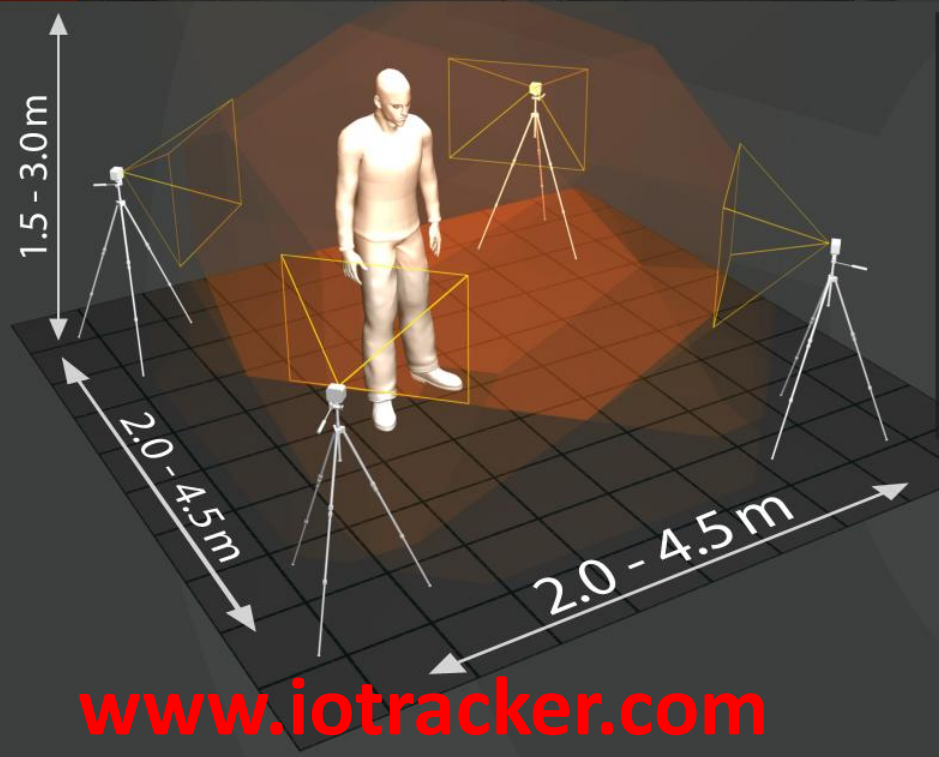
A. Mossel, C. Schoenauer, G. Gerstweiler, H. Kaufmann: ARTiFICe - Augmented Reality Framework for Distributed Collaboration, *IEEE VR Workshop on Off-The-Shelf Virtual Reality (IEEE Virtual Reality 2012),* March 2012, Orange County, CA, USA

T. Pintaric, H. Kaufmann, Affordable Infrared-Optical Pose-Tracking for Virtual and Augmented Reality, *in Proceedings of Trends and Issues in Tracking for Virtual Environments Workshop*, IEEE VR 2007, Charlotte, NC, USA, 2007

iotracker

affordable infrared-optical pose tracking

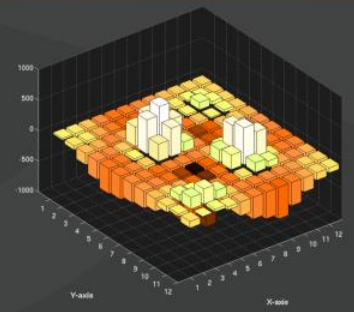
TU VIENNA
Technische Universität Wien
Vienna University of Technology



specifications

Update rate: **60 Hz**
Latency: **18 - 40 ms**
Jitter: **< 0.05 mm / 0.02°**
Accuracy: **± 0.5 cm**

FireWire



www.iotracker.com