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COGNITIVE ASPECTS OF COLLABORATION IN 3D VIRTUAL ENVIRONMENTS

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Carto4 3D eu

Introduction

- Part of the project: „**Influence of cartographic visualization methods on the success of solving practical and educational spatial tasks**“
  - March 2016 – December 2018
  - Work in progress …
  - Interdisciplinary research

    Faculty of Science – Department of Geography

    Faculty of Arts – Department of Psychology

    Faculty of Education – Department of Geography

    Faculty of Informatics – Department of Computer Graphics and Design

Research Aims

- Main research questions:
  - how different methods of visualization and user interfaces (UI) affects the way of solving spatial tasks by individual person or by group of people
  - and how they affect the efficiency of processing and interpretation of spatial information and learning
- Partial aims are the assessments of the impacts of:
  - basic types of cartographic expression variables on cognitive processing and interpretation
  - elementary perceptual and memory processes in the interpretation of maps and remote sensing materials
  - various cartographic methods and types of visualization on cognitive processing and interpretation
  - different UI on the formation of adequate mental representations and decisions in experimental tasks
  - various types of UI in the context of cooperative education

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Published studies

- Špriňarová, K., Juřík, V., Šašinka, C., Herman, L., Šterba, Z., Stachoň, Z., Chmelík, J., Kozlíková, B. (2015). **Human-computer Interaction in Real 3D and Pseudo-3D Cartographic Visualization: A Comparative Study**. In: Sluter, C. R., et al. (eds.) *Cartography - Maps Connecting the World: 27th International Cartographic Conference 2015 - ICC2015*. Springer, pp. 59-73.
- Herman, L., Řezník, T. (2015). **3D Web Visualization of Environmental Information – Integration of Heterogeneous Data Sources when Providing Navigation and Interaction**. In: Mallet C., et al. (eds.) *ISPRS Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences, Vol. XL-3/W3*. La Grande Motte, France, pp. 479-485.
- Šterba, Z., Šašinka, C., Stachoň, Z., Štampach, R., Morong, K., (2015). ***Selected Issues of Experimental testing in Cartography***. Masaryk University, MuniPress, Brno.
- Herman, L., Stachoň, Z. (2016). **Comparison of User Performance with Interactive and Static 3D Visualization – Pilot Study**. In *ISPRS Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences, Vol. XLI-B2*. Prague, Czech Republic, pp. 655-661.
- Juřík, V., Herman, L., Chmelík, J., Šašinka, C., Stachoň, Z. (send to SC&C journal) **Is more less? The Three-dimensional Interaction with Virtual Geographical Environments**.

Virtual Reality and Collaboration

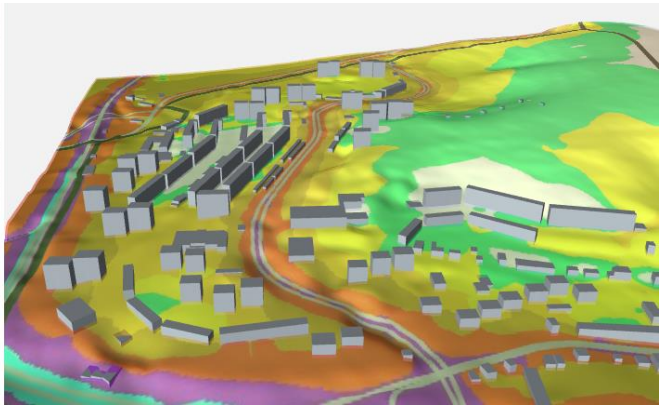
- Collaboration (or cooperation)
  - is as a social activity that uses the knowledge, skills and efforts of a few individuals to achieve group goals, which could not be achieved by individuals working alone (Levan, 2004)
- Virtual collaboration
- Virtual reality (VR)
  - is the application of computer technologies to create interactive, 3-dimensional world, where the operator feels to be present (Bryson, 1999)
- Multi-User Virtual Environment (MUVE)
  - importance of social, cooperative, on-line communication and interaction are emphasized

Psychological Perspectives

- Brunswik's theory
  - cyclic activity based on the active motor action of observer
- Embodied cognition theory
  - bodily elaborated information has different quality than only visually communicated information (Meteyard et al., 2012)
  - mentioned also by Wilson (2002) or Anderson (2003)
- Presence or also immersion
  - “the feeling of being there”
  - Described in detail by Mania et al. (2006)
- Engagement
  - the involvement of users into VR (Bakker et al., 2011)

Cartographic Visualization

- Variety of cartographic visualization methods suitable for 3D environment
  - from realistic visualization (photorealistic rendering)
  - to the abstract simplistic depiction
- Functionality (efficiency) of selected cartographic visualization methods is also influenced by purpose of visualization, given task, used UI, user abilities …



Photorealistic visualization (Google Earth) and abstract visualization of 3D noise map. Area of city district Nový Lískovec (Brno, Czech Republic)

Available Equipment

- Two stereoscopic projection walls with passive glasses, both with Motion Capture systems
- Several 3D monitors with shutter glasses
- Several Occulus Rift DK2
- Occulus Rift DK2 with SMI Eye Tracking HMD Upgrade
- AR glasses (e.g. Vuzix Wrap 1200AR)
- Nintendo Wii controllers, Microsoft Kinect sensors, 3D mousses, touch screen, ….
- SMI RED 500 and EyeTribe
- …

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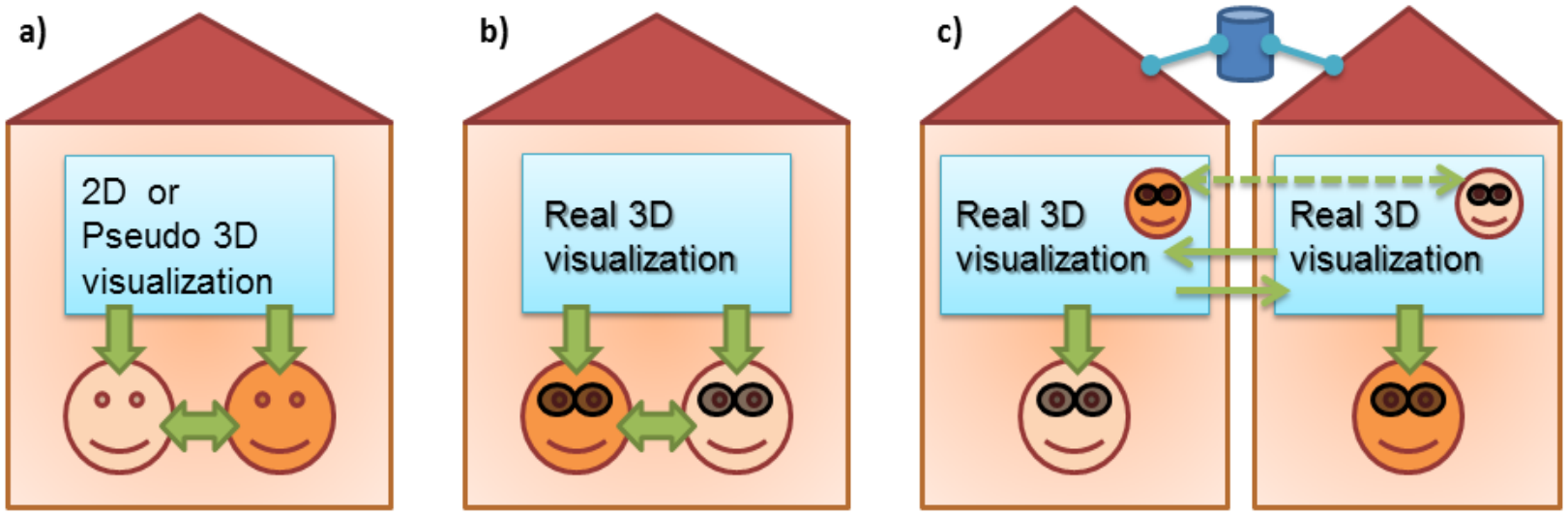
Software

- Hypothesis
  - web based platform for experimental testing, which was designed especially for the assessment of map usability
  - can used for the research of virtual collaboration based on 2D visualizations
  - is developed by Department of Geography (Faculty of Science) and Department of Psychology (is described in detail in Šterba et al., 2015)
- VRECKO
  - software platform for 3D visualization
  - is applicable to providing only individual task solving or direct cooperation of users
  - is developed by the Department of Computer Graphics and Design
- Unity
  - is originally cross-platform 3D game engine currently modified by Department of Computer Graphics and Design
  - can be used for virtual collaboration with spatial data and networking thanks to the multiplayer mode support

Possible Utilization of Equipment

- Three types of collaboration

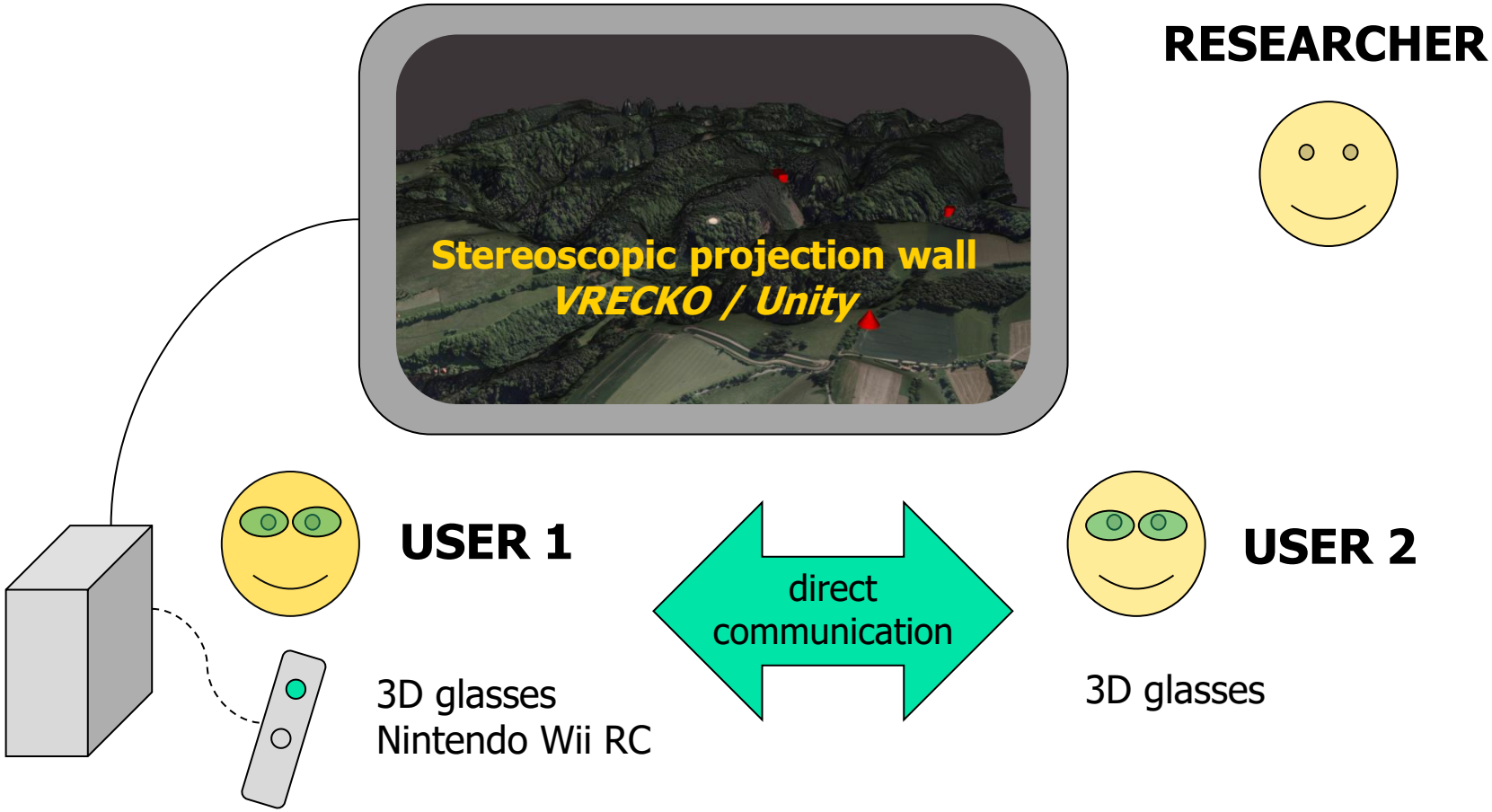


shared space
direct eye contact
interaction takes place
undisturbed

shared space
difficult direct eye contact
increased focus on 3D map

shared virtual space
on-line communication
users monitor the activity of the second user

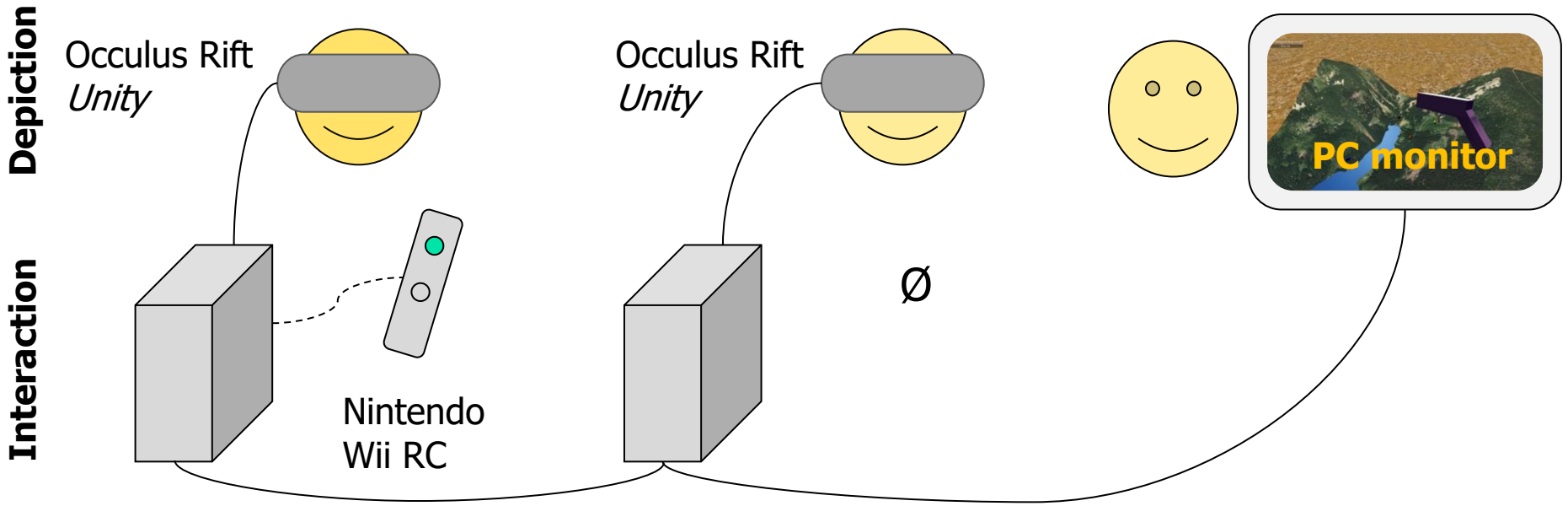
Our Version of MUVE – *type b*



Our Version of MUVE – *type b*

Individual user is solving task in 3D virtual environment

Current Version of MUVE – *type c*



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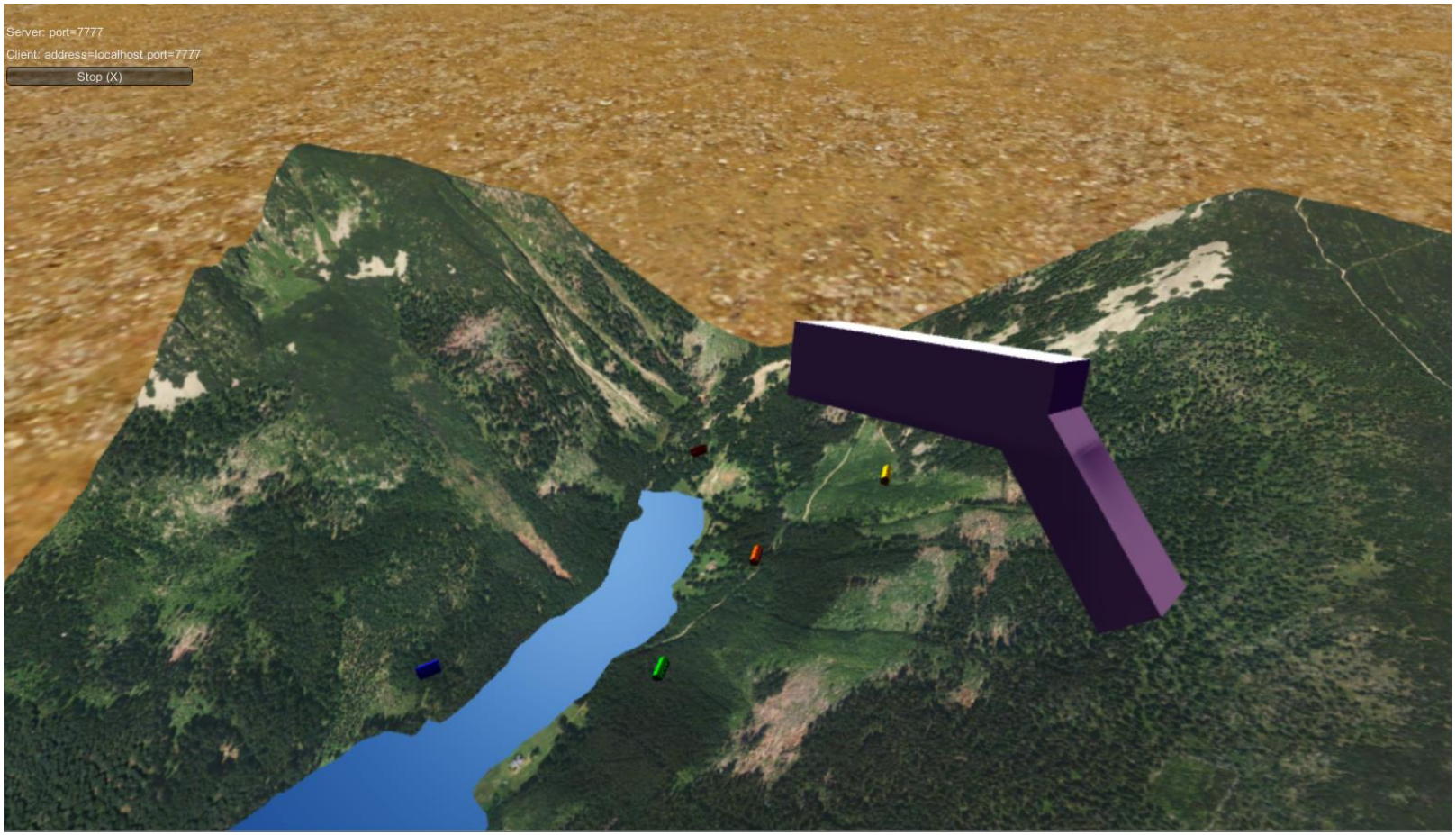
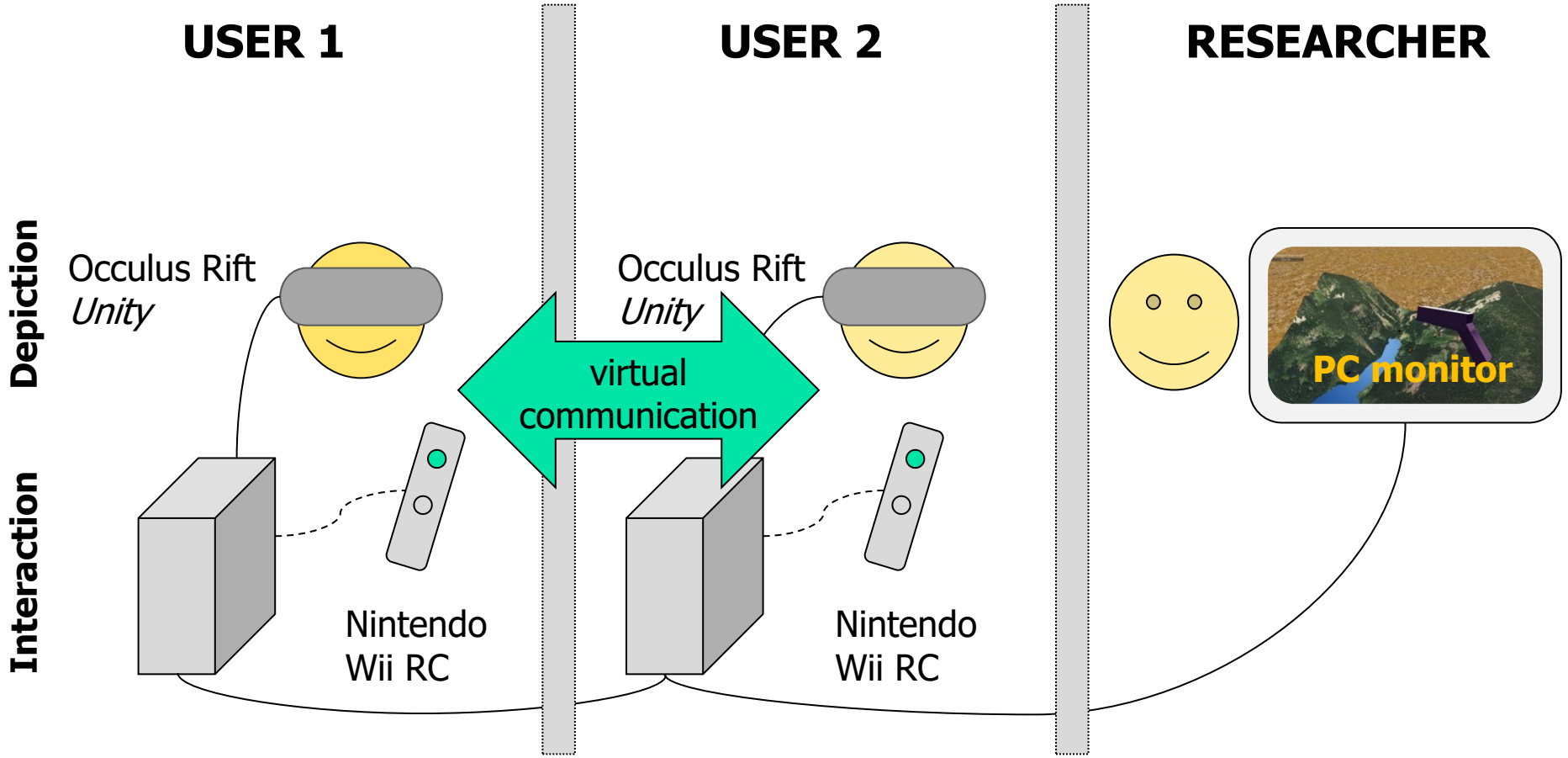
Our Version of MUVE – *type c*

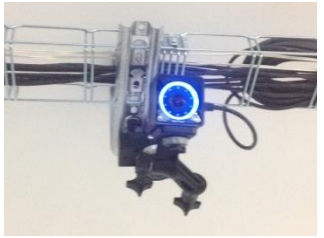


Future Version of MUVE – *type c*



Future Development

- We suggested the possibilities of establishing the variable platform for the research of virtual work and collaboration, but many of the theoretical, technological and methodological aspects still remain to be explored
- Development of software platform
  - On-line audio communication
  - Support of multiple devices for user interaction
- Use of multiple devices (Motion Capture, mobile eye-tracking, EEG) for evaluation of users strategies
- Pilot test, 1st experiment, 2nd experiment, 3rd experiment, ….



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THANK YOU FOR YOUR ATTENTION!

QUESTIONS …

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