VIEW: A CONCEPT FOR AN IMMERSIVE VIRTUAL REALITY IMAGE INTERPRETATION WORKBENCH

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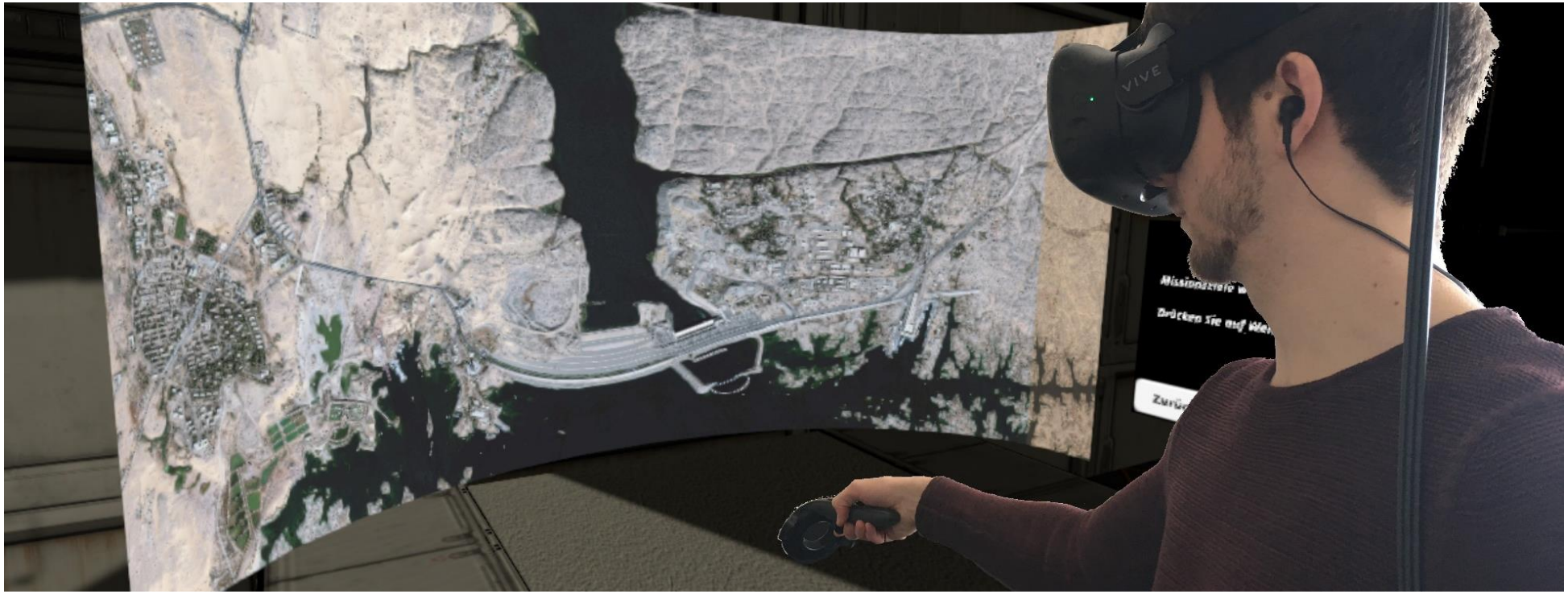
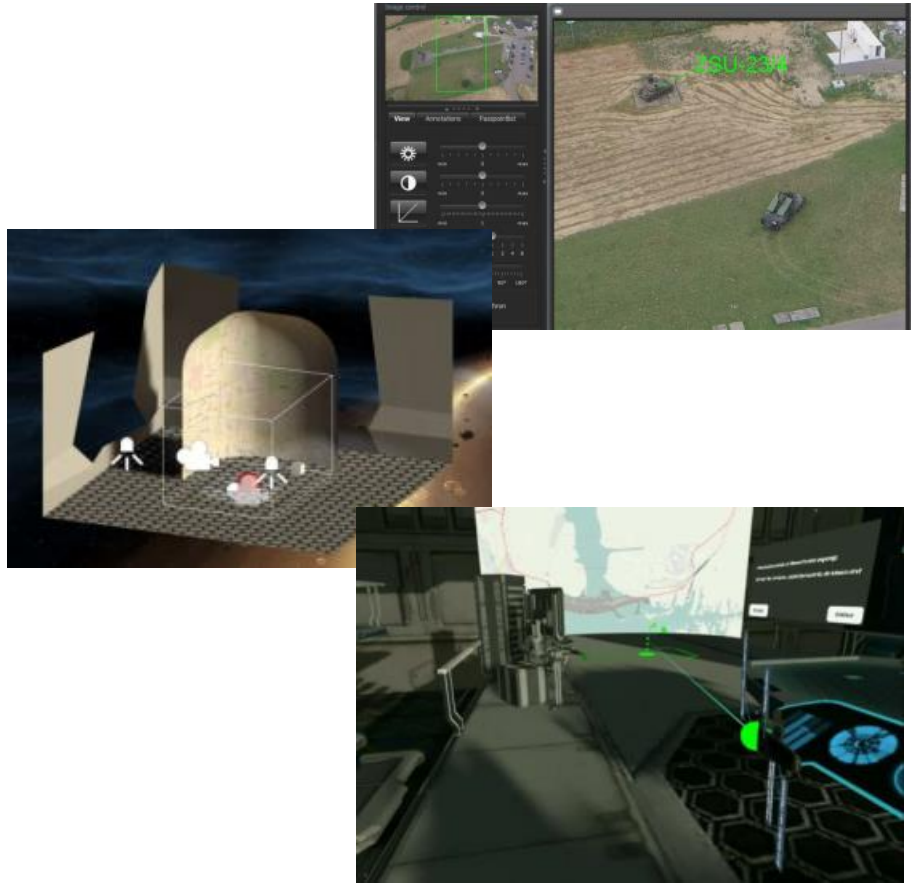
Alexander Streicher, Julien Hoffmann, Wolfgang Roller



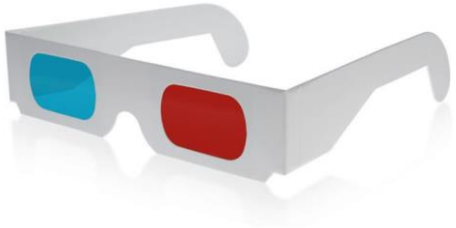
AGENDA

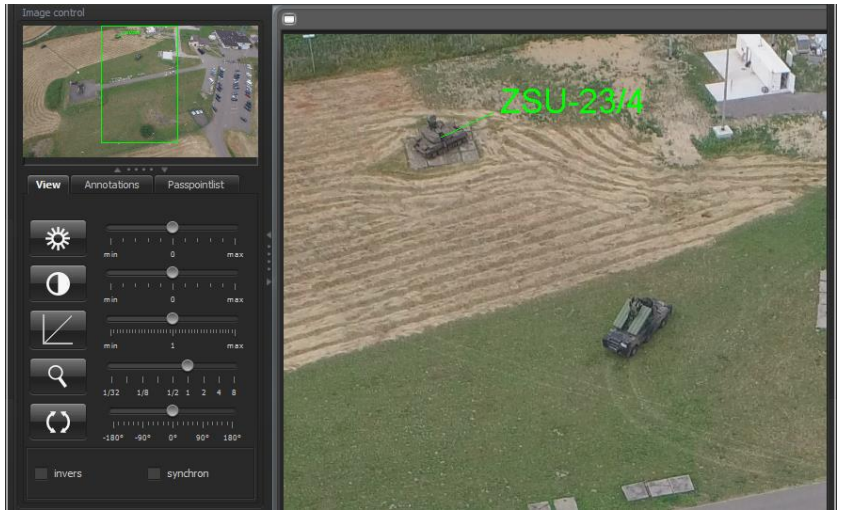
- Motivation
  - Research question
  - Challenges
- Empirical study on VR & Image Quality
- VIEW Concept, System Design
- Prototype
- Preliminary Evaluation
- Conclusion & Outlook



Motivation
Why are we doing this?

- Research question: *How to built effective VR apps for professional image interpretation training which enable immersion and exploit spatiality experience?*
- In the past:
  - complicated spatiality experience, i.e., blue-red glasses for anaglyph 3D, e.g., for topography
  - multi-monitor/dome display setup
- Now:
  - COTS VR hardware
  - 3D immersion





ViLand (Fraunhofer IOSB)

Motivation
Huge Images? MORE Displays!

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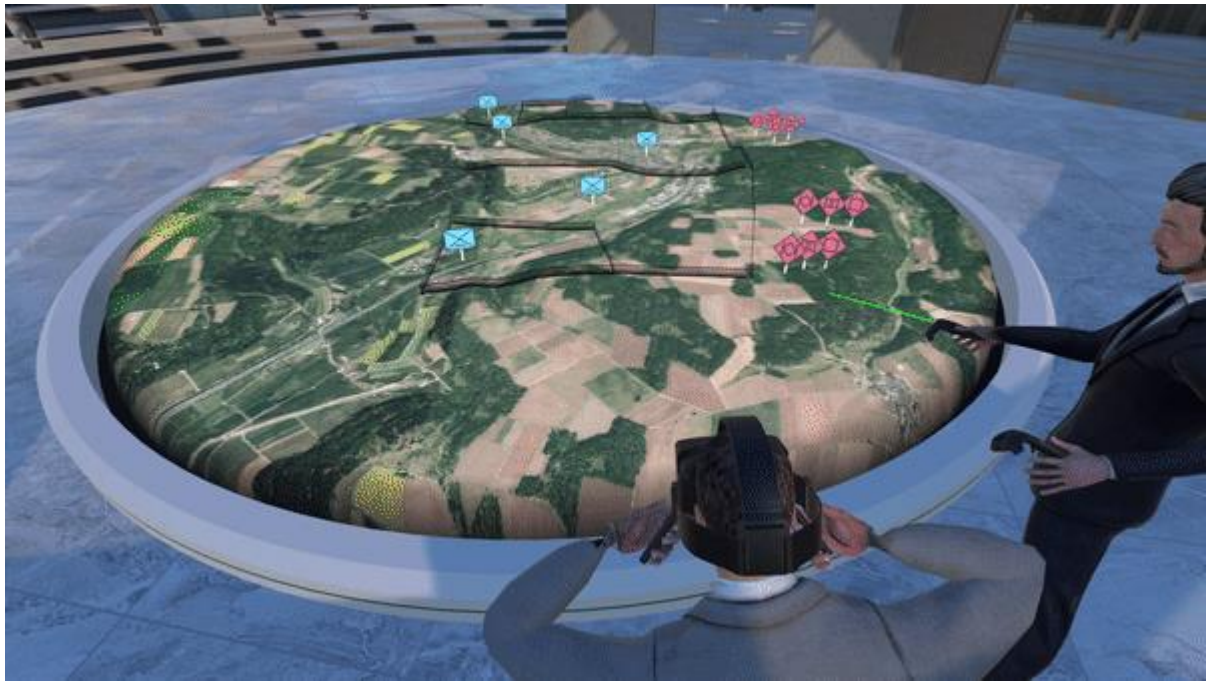
… or go VR?



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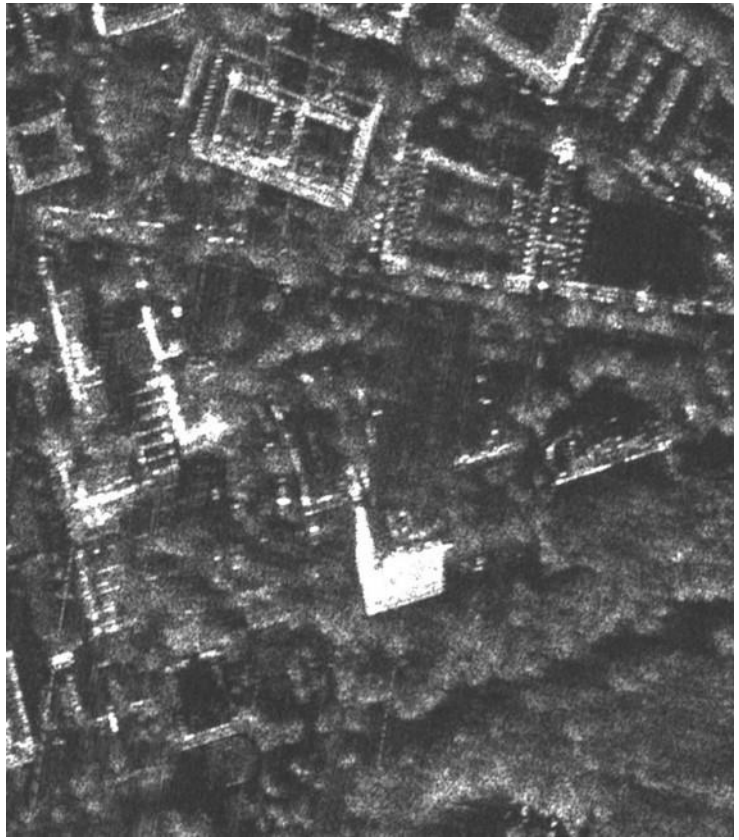
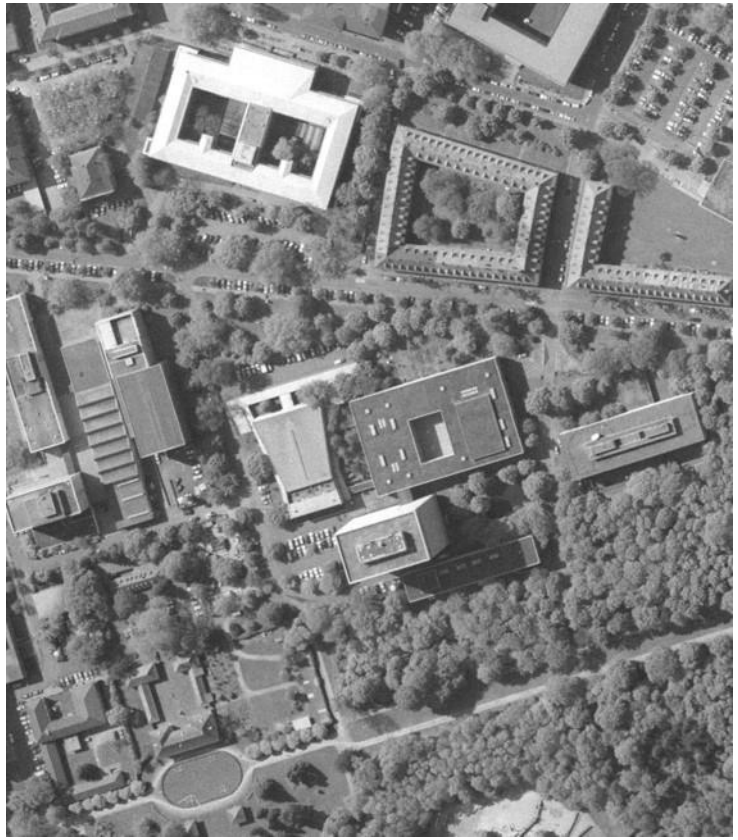
Motivation
Image Interpretation / Exploitation

SAR



Optical



Challenges to built a VR Image Exploitation Workbench

How to…

Effect

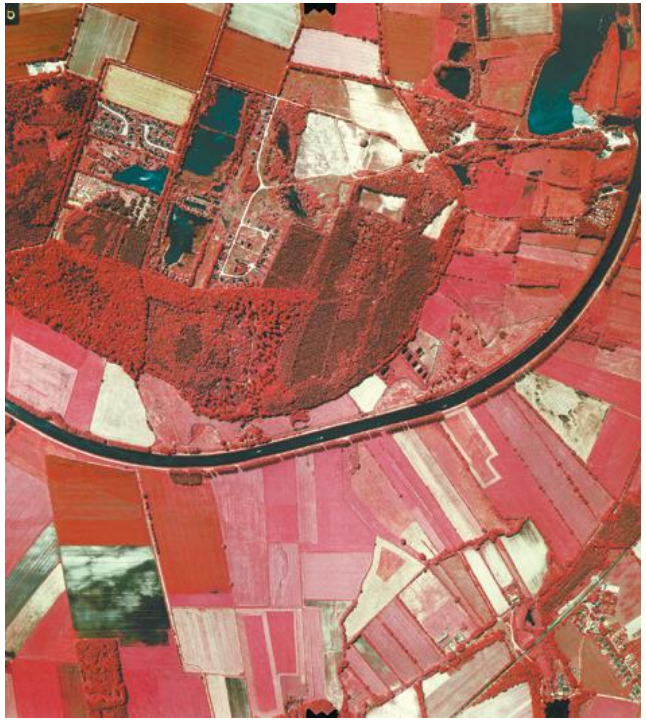
- achieve high level of professionalism?
- exploit serious gaming principles to improve immersion and learning efficacy?

Tech.

- use consumer-grade COTS VR hardware?
- use common game engines to display giga-pixel imagery data, e.g. high resolution radar images?

Usability

- achieve high usability, high affordance?
- find best suited VR HCI paradigms?
  - No standards exist (yet) [Hop2016, Hof2017]
  - Professional context vs. entertainment
  - Missing VR immersion design guidelines [Mal2015, Hof2017]



CIR Elbe-Lübeck Canal Siebeneichen, GeoDZ.com

Methodology

1. Literature review: VR in professional contexts (focus on image exploitation)
2. Empirical research on *perceived* VR image quality
3. Concept
    1. VR high resolution image displays
    2. VR HCI
    3. VR immersion
4. Prototype implementation
5. Verification, study

EVALUATION OF PERCEIVED VR IMAGE QUALITY

- Experiment to investigate the subjectively perceived image quality in VR [Hof2017]
- Viewing of different textures in Unity3D and Unreal Engine test scenes
- Literature research on known issues [Hof2017]

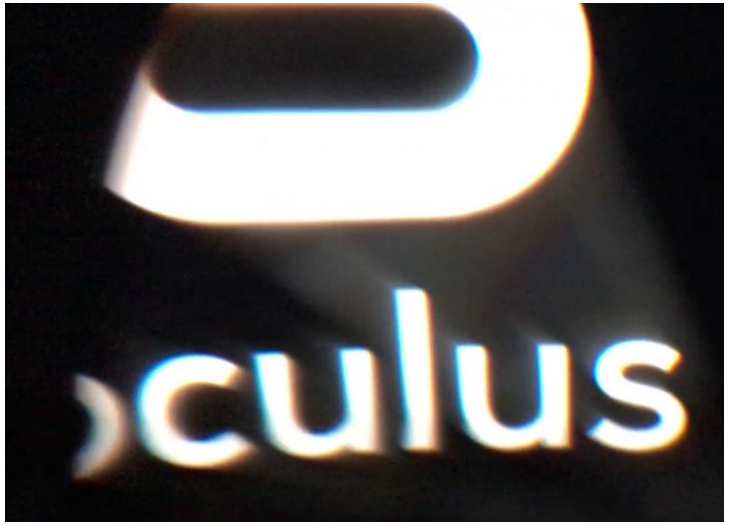
Screen Door Effect

horobox.co.uk

Ring Effect

Medium.com

Lightray Effect



Oculus / Facebook

Fraunhofer IOSB

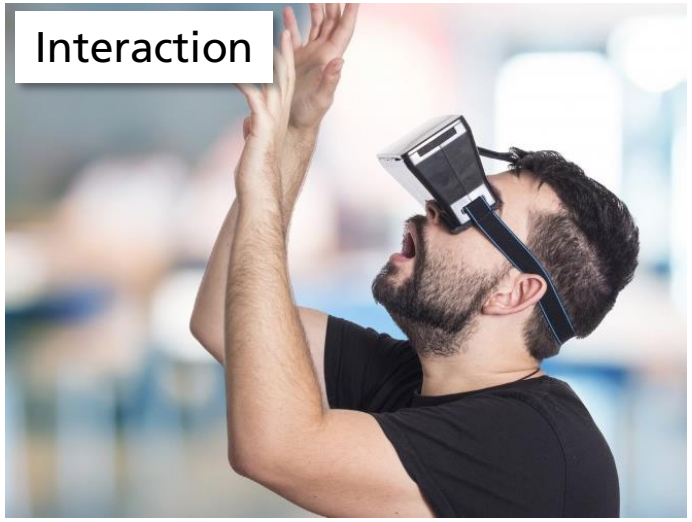
VR & Image Quality

[Hof2017]

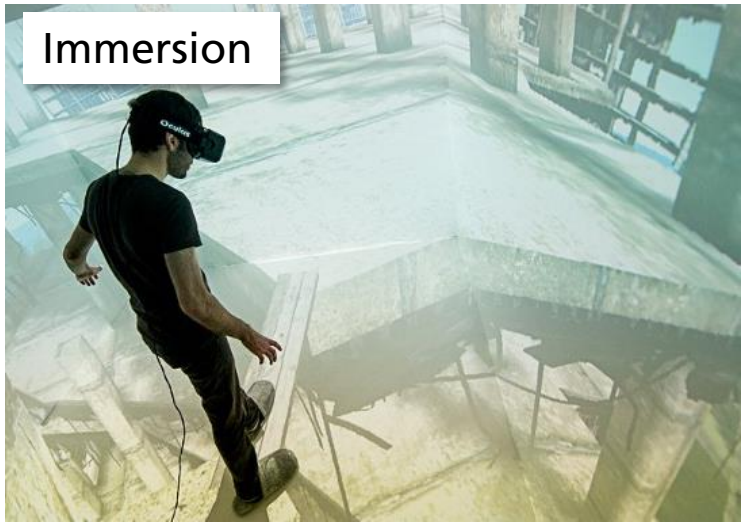
- **Perceived Conspicuousness** of artefacts in experiment is lower than expected [Hof2017]
- **Headset Placement** – some artifact effects can be minimized by correct headset setup
- **Game engine settings** have significant impact on image fidelity (e.g., LOD, filters)
- **Small elements** (e.g., text) can be viewed more easily at close range

Julien Hoffmann: Virtual Reality für Assistenzsysteme in der Bildauswertung (Virtual Reality for Assistance Systems in Image Exploitation); KIT, Fraunhofer IOSB; Master Thesis, 2017

HUMANS & VR



umbra3d.com

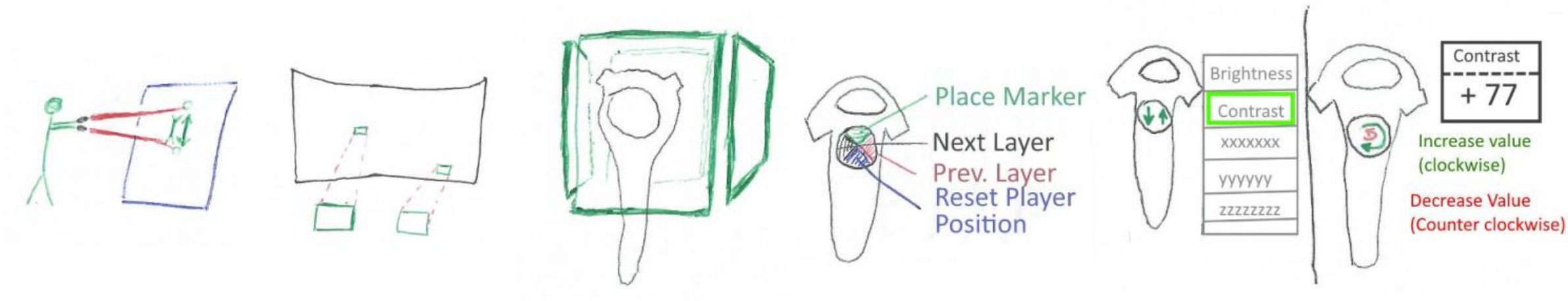


HigheredRevolution.com

Medium.com

Interaction Design

- No VR interaction standards exist (yet) [Hop2016, Mal2015]
- We researched concepts and paradigms in other VR applications
- We developed own concepts best suited for image interpretation
- Avoiding locomotion sickness pitfalls [Pal17, JeSc16, Ken00, Mal, Fer16, Hec16]



Serious Gaming, Immersion

- Serious games = games with a characterizing goal, e.g., learning
- VIEW focus: e-learning for image interpreters, e.g., learning how to systematically interpret images
- Gamification by
  - re-using scenery from real serious game for image interpretation (game *Lost Earth 2307*)
  - narrative/story
  - competitive components (“*who is faster in level xy?*“)

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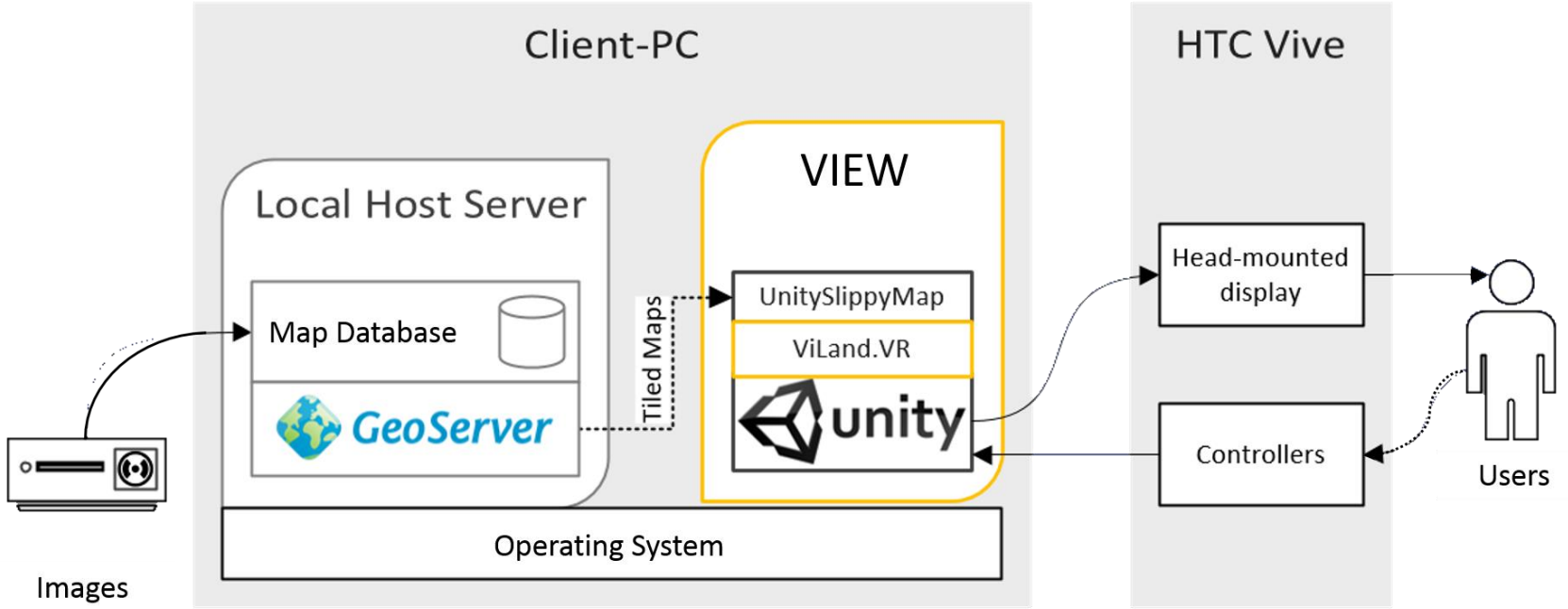
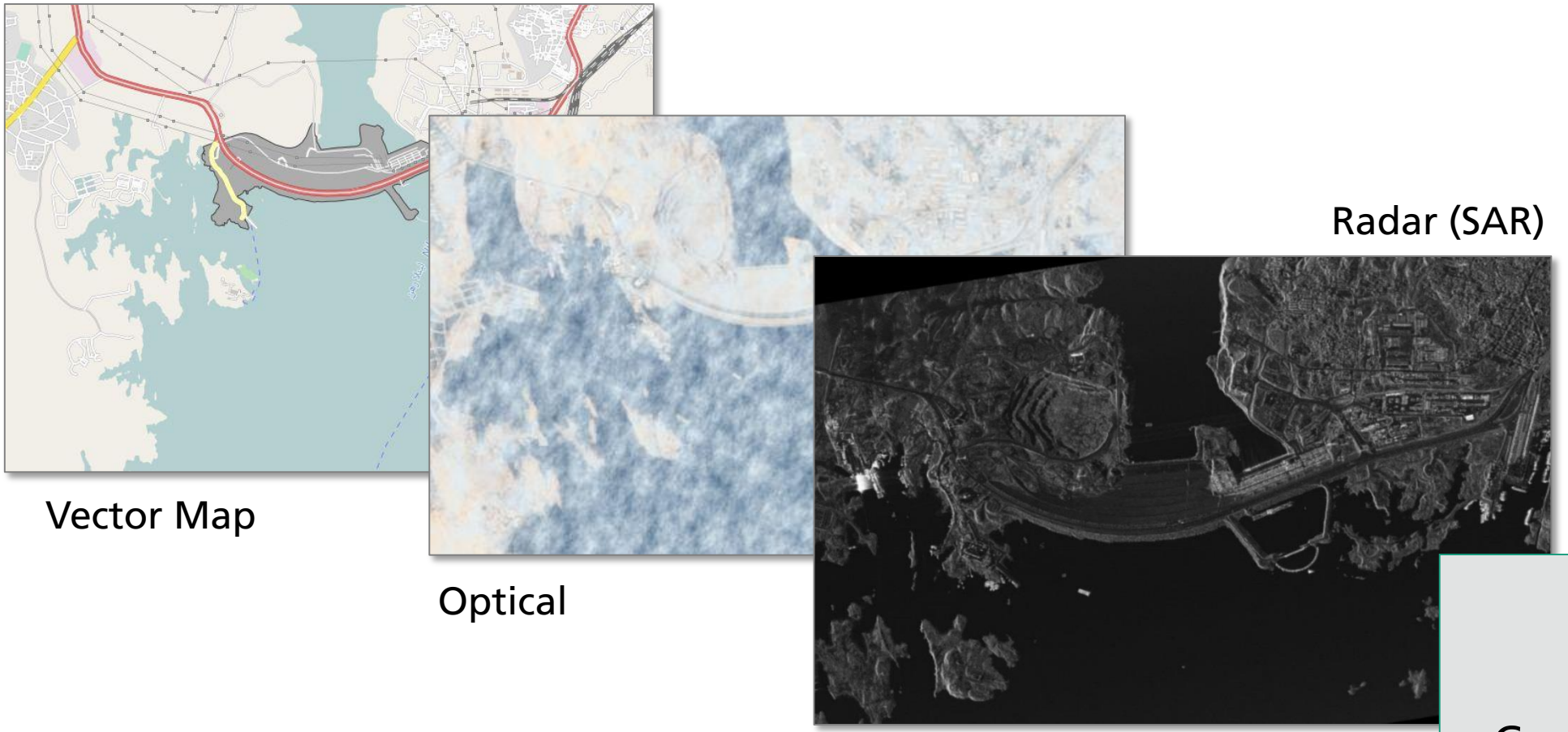
IMPLEMENTATION

- Virtual Reality Image Exploitation Workspace – **VIEW**
- Service-oriented architecture, GeoServer, WMS, TiledMap
- Prototype for evaluation



[Hof2017]

Imagery Channels



Vector Map

Optical

Radar (SAR)

Infrared,
Hyper-spectral,
…

…
(other
GeoServer layers)

Demonstration – Setting/Environment and Locomotion

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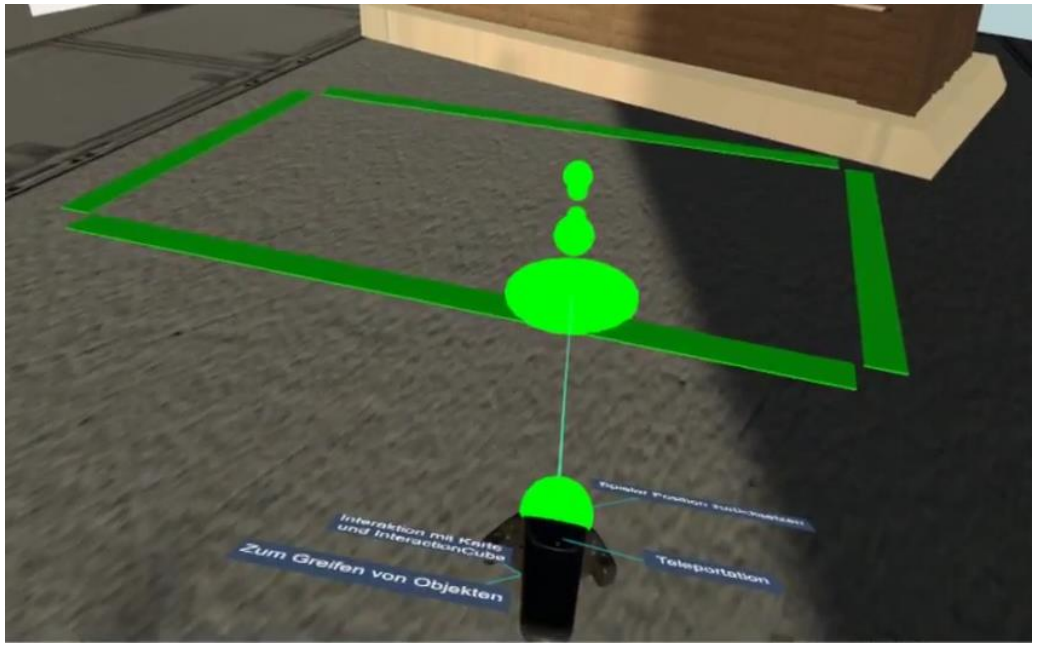
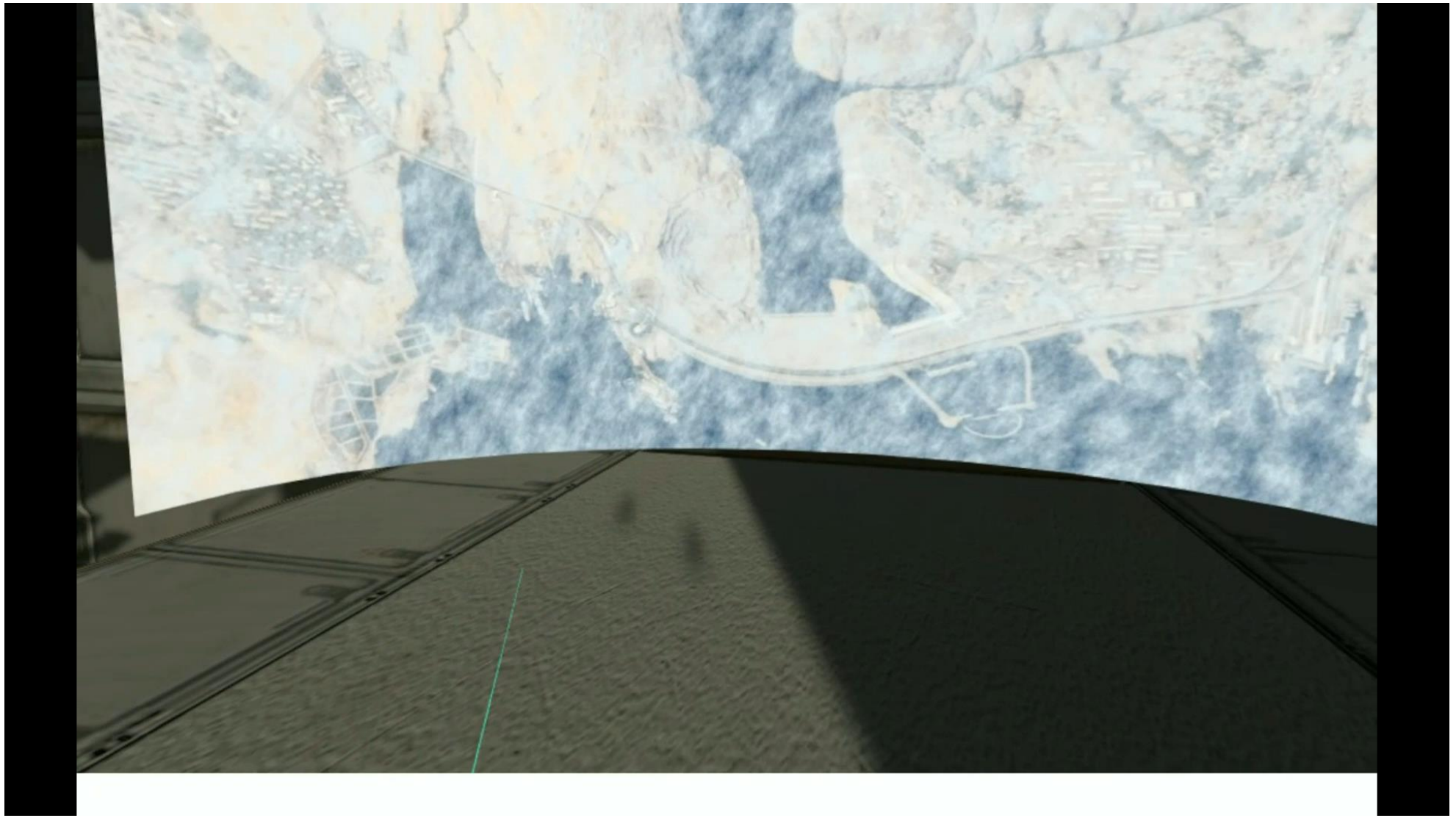


Demonstration – MapDisplay and InteractionCube



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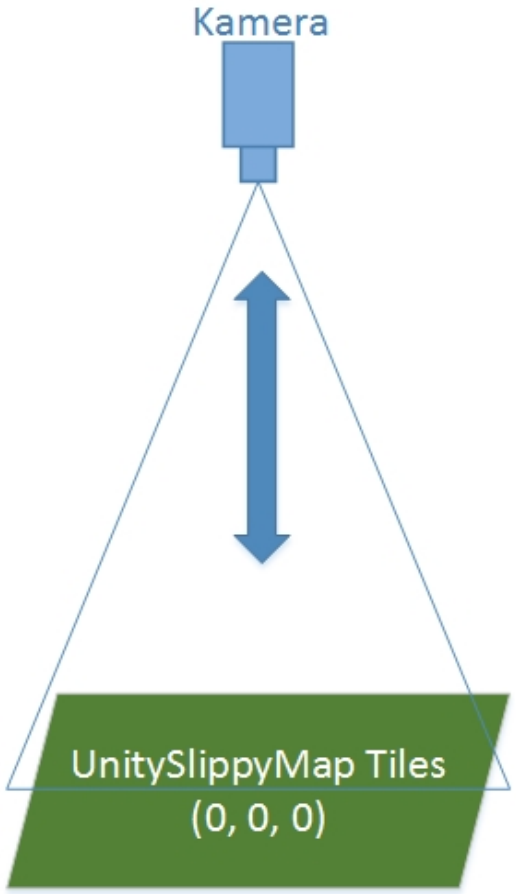
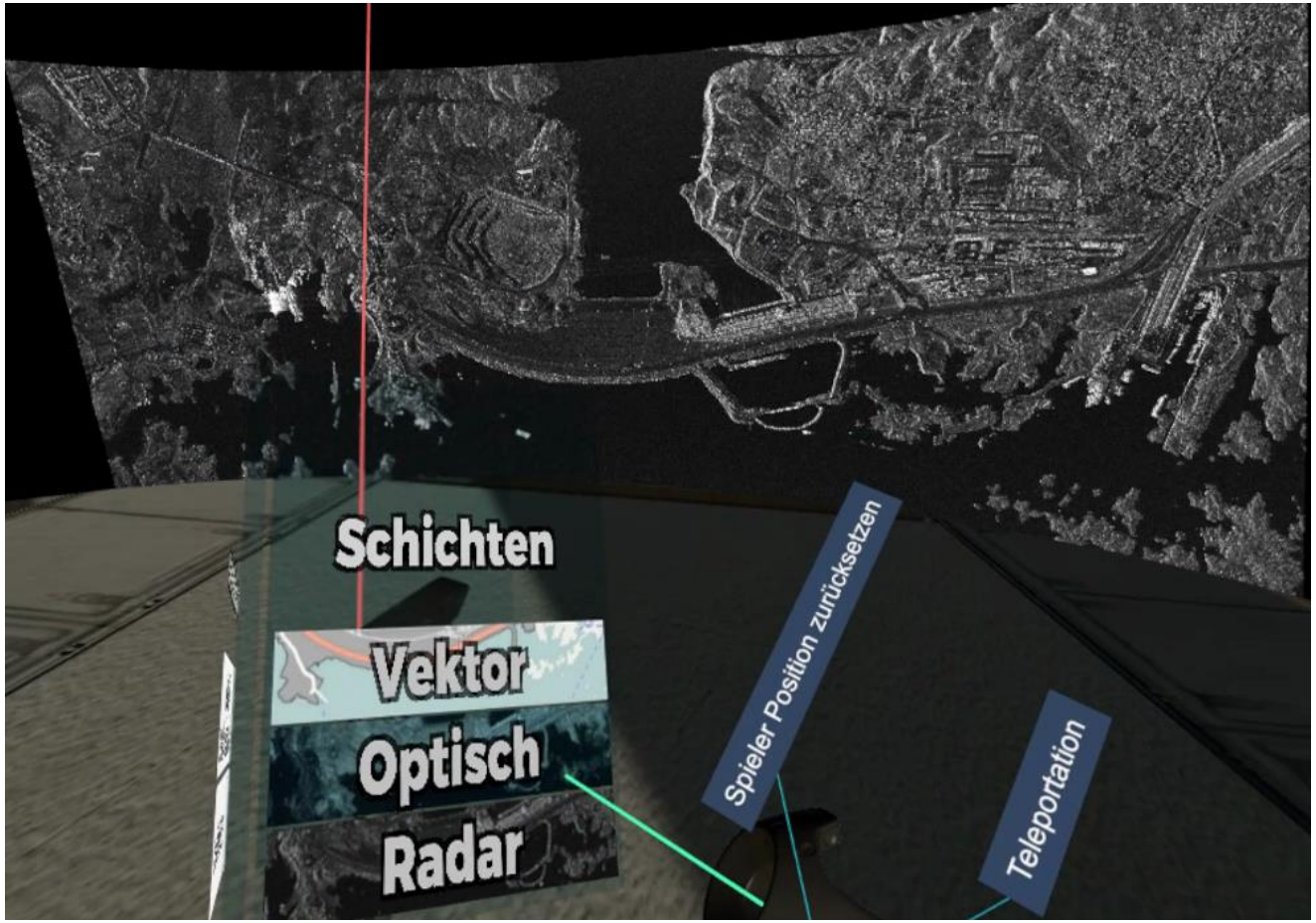
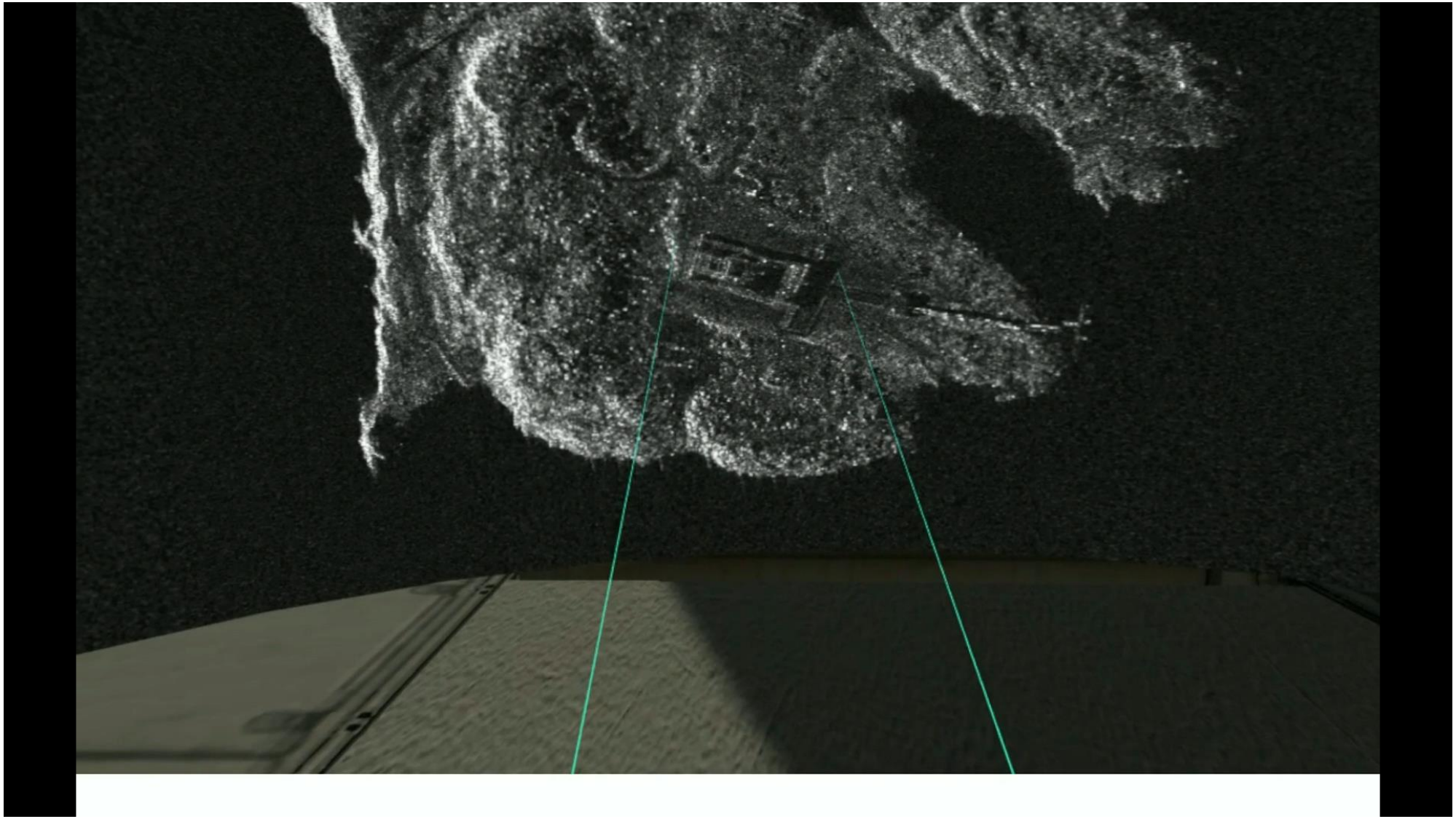




Demonstration – 3D Mode



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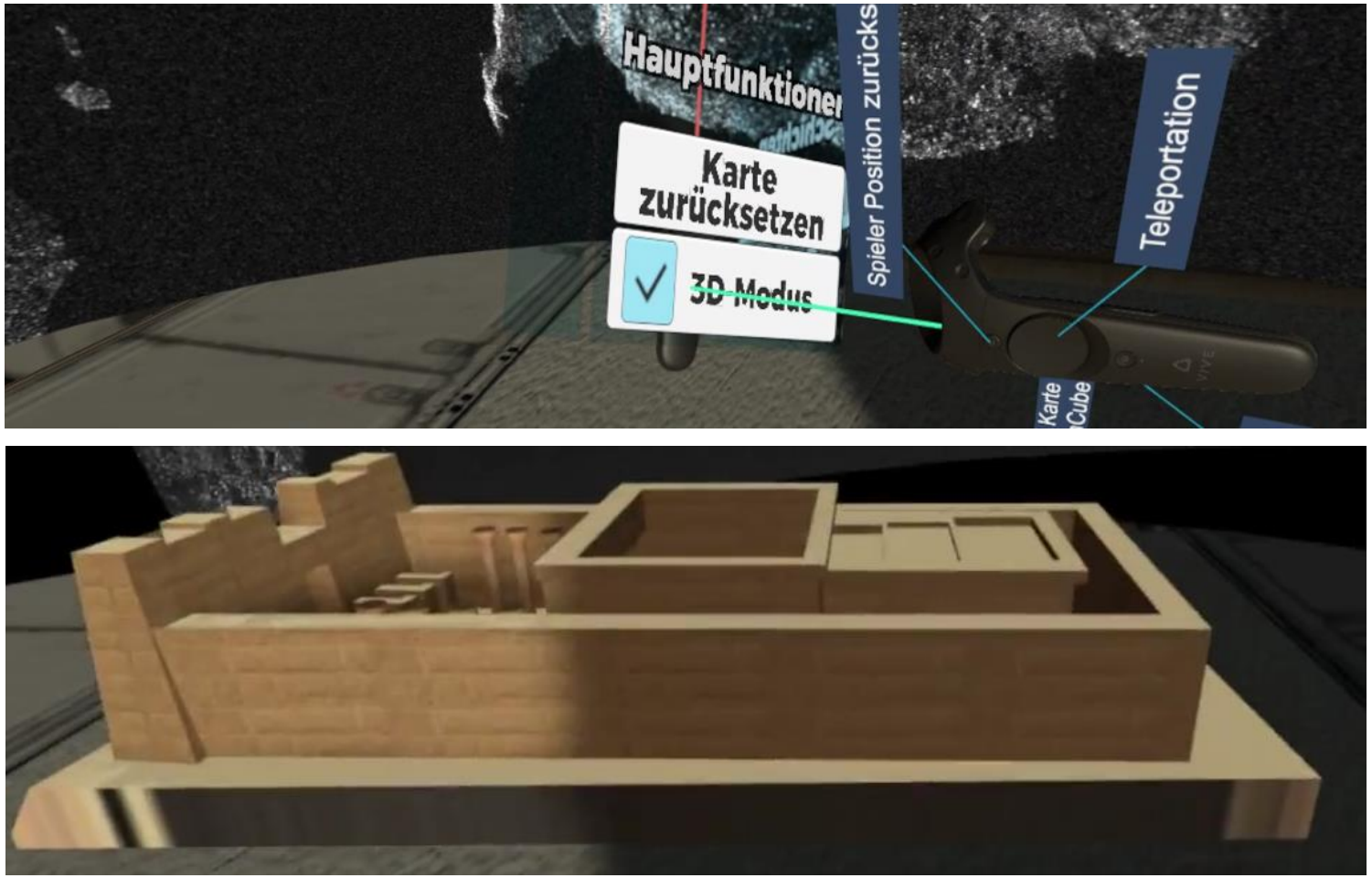
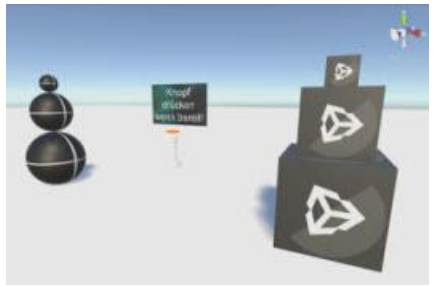
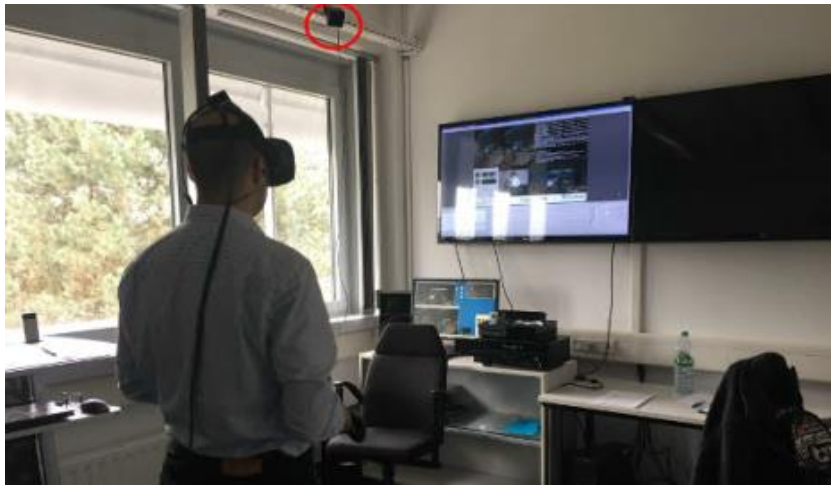


EVALUATION

- Evaluation is *Work in Progress*…
- n = 16 users, 35 years avg. (21-59), 14 ♂, mainly computer science students
- Identical settings, VR hardware (HTC Vive), software version, etc.
- Individual adjustment of VR hardware, e.g., pupil distance
- Introduction by test conductor
- Tutorial level
- VIEW presents user with gamified story/narrative
- Scenario oriented at image exploitation tasks (e.g., analyze, identify, report)

Pupil Distance


Tutorial Level


Setting

Preliminary Evaluation Results

» I felt comfortable on the bridge. I'd very much wanted to continue walking there all the time. «

» The game elements were fun and motivated to carry on with the task. «

» Interaction with map was super! Scaling as intuitive as expected. It was super that the map got caught exactly on the [pointing] ray. «

» Immersion definitely improved. «

» My hands are not to be seen, that would be cool - I do not know if that's possible. «

» The sound does create a higher immersion, but I'd like to have my rest at work «

» Grip is difficult because the button on the controller is placed oddly. «

Conclusion & Outlook

- Concept for VR for image interpretation: VIEW – Virtual Image Interpretation Workspace
- VR especially well-suited for high immersion and spatiality experiences, e.g., 3D models
- High resolution imagery, tiling approach with GeoServer and WMS
- Preliminary evaluation shows positive resonance (usability, HCI concepts, immersion)

Outlook

- Evaluate usability, immersion & presence, image interpretation and learning efficiency [Li09]
- Use newer VR technologies (4k, 8k, higher pixel density, *Foveated Rendering* [FoRe16], etc.)

Thanks for your attention!
Questions? Comments?
Discussion.

Dipl.-Inf. Alexander Streicher
alexander.streicher@iosb.fraunhofer.de

Fraunhofer-Institute of Optronics, System Technologies and Image Exploitation IOSB
Dep. Interoperability and Assistance Systems (IAS)
Fraunhoferstr. 1, 76131 Karlsruhe, DE
www.iosb.fraunhofer.de

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