Explorative Point Cloud Virtual Reality: Immersive Visual Insight

Evaluating User Perception, Interaction and Immersion with VR and Omnibase

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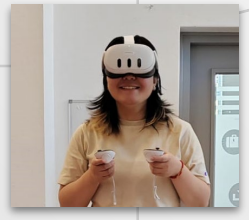

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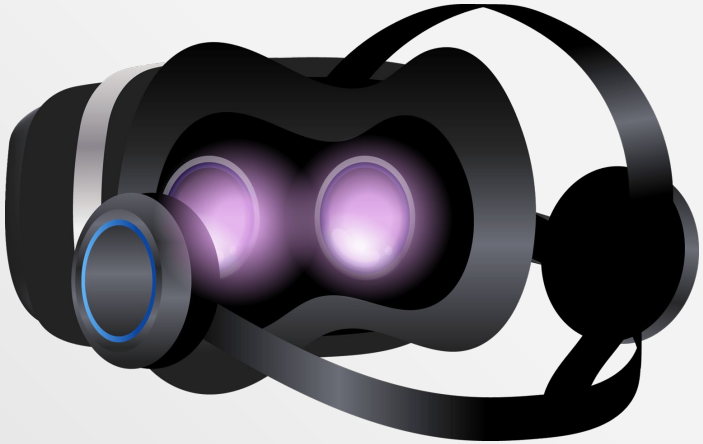
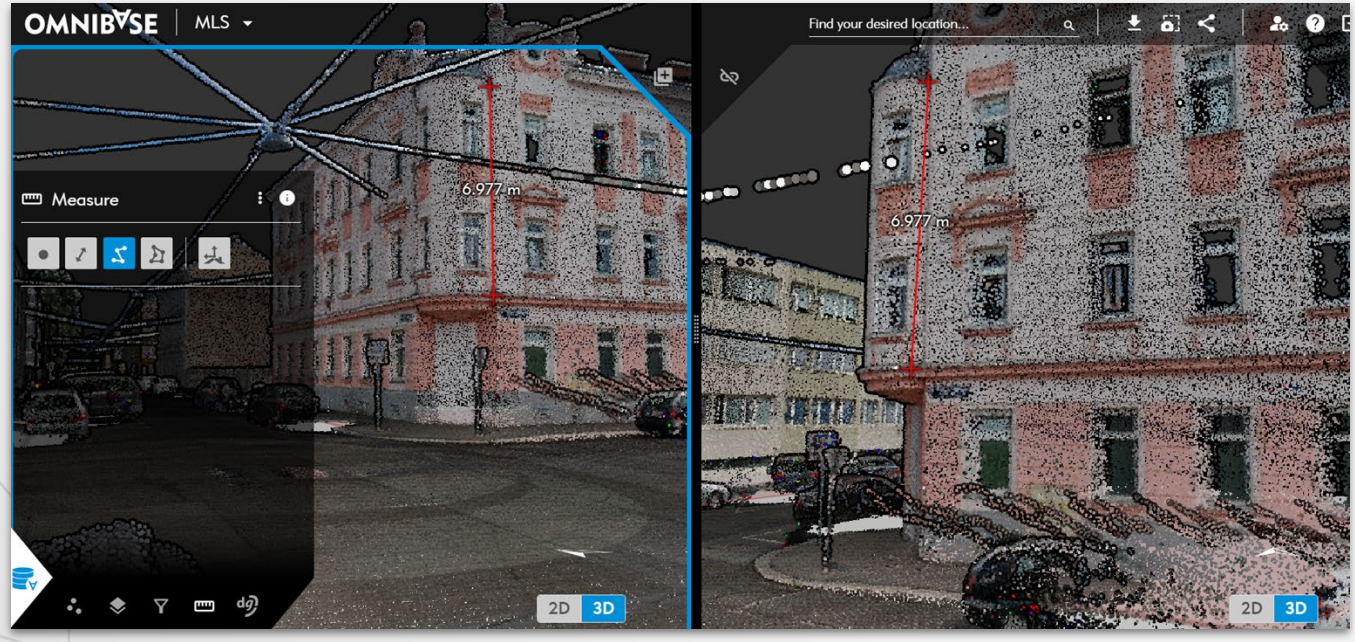
Introduction



The Problem



- Complex point clouds
- 3D to 2D conversion issues
- Depth & scale loss
- VR as possible solution

Geodelta. *Omnibase Software. 2024.* https://www.geodelta.com/en/software/omnibase

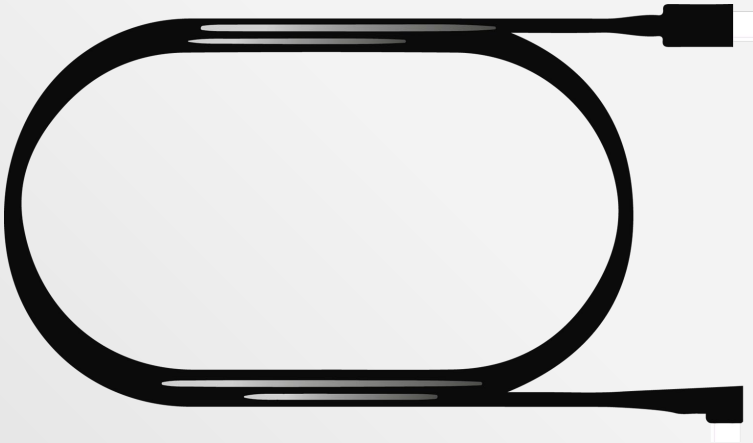
Research Question

How does the use of Virtual Reality, compared to Omnibase's multi-view, affect:

- User perception
- Interaction, and
- Relative measurement accuracy

For users that are either **familiar or unfamiliar** with **point clouds**

Technical Background



Technical background

Omnibase

- Web-based software
- Geospatial data
- Clients - municipalities

Multi-view

- Split screens
- Different perspectives
- Precision and Depth

Geodelta. *Omnibase Software. 2024.* https://www.geodelta.com/en/software/omnibase

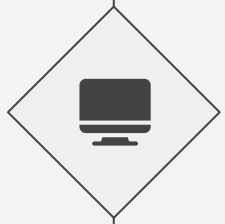
Related Work

Web - Based Point Clouds & Potree

LoD → Dynamically load necessary data base on user's view

Octree Structure → Breaks dataset into manageable sections

Interactive Measurement Tools → Limited to 2D



Virtual Reality & Point Clouds

- Enhanced depth perception and spatial awareness
- Detailed and engaging interaction
- Enhancing speed and accuracy of tasks like annotation and exploration

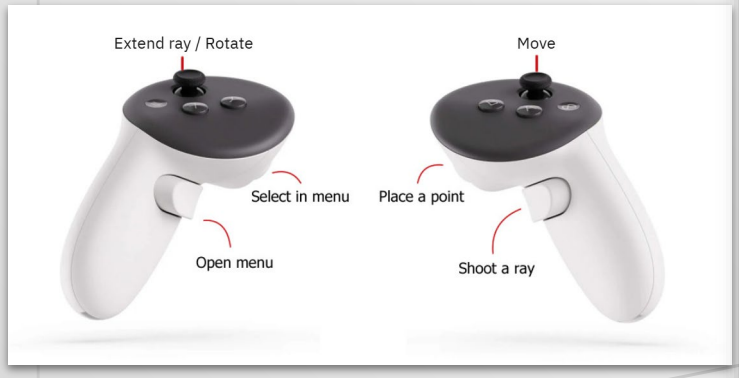
Implementations & Challenges

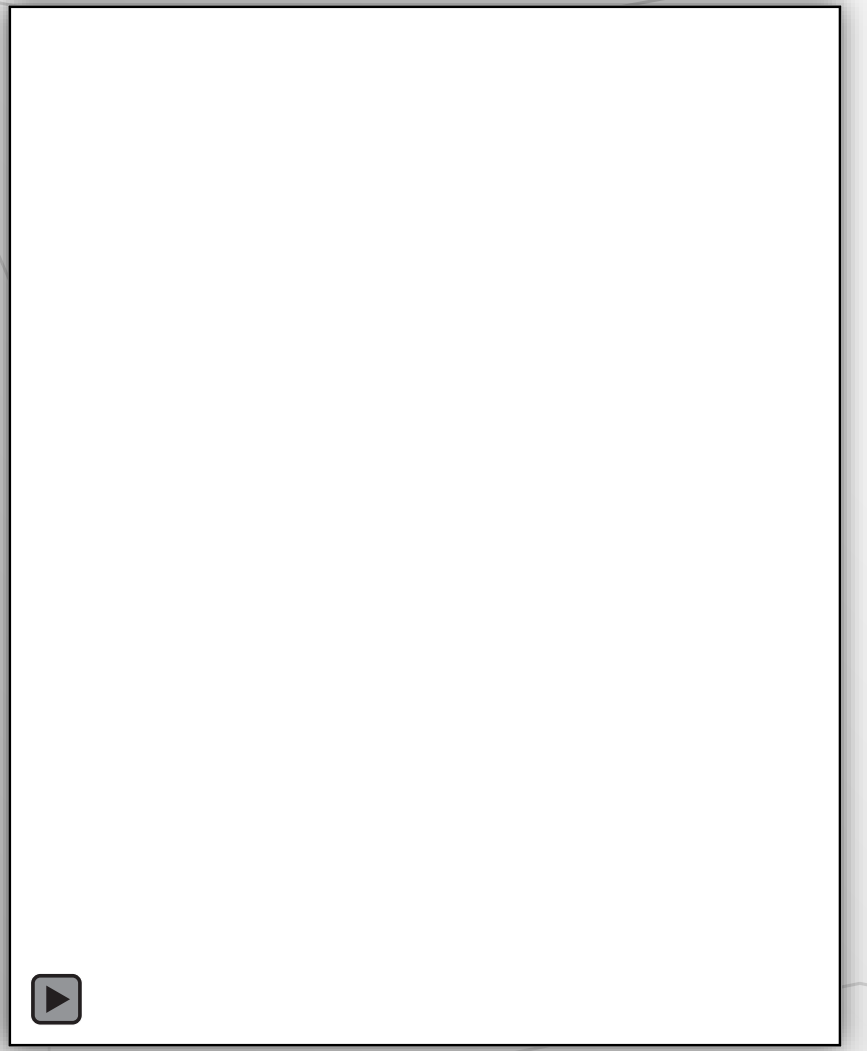
Setup

- **High-performance PC:**
  - GPU and CPU
- **VR Headset & Controllers:**
  - Meta Quest 3
- **Source code Potree:**
  - Node.js
  - Point cloud file (Potree format)
- **Browser:**
  - WebXR and WebGL support
  - Oculus browser

Navigation & Controls

- Eye level movement
- Joystick-based rotation
- Reduced sensitivity for realism





Measurement Tools

- Point Addition
- Adjustable ray length
- Line Measurement
- Area Measurement
- Measurement Labels
- Deleting Measurements

Challenges encountered

- Point cloud interaction and coordinate system alignment with VR
- Potree's 2D-based structure created issues for 3D point selection and accuracy.
- Limitations in mesh handling prevented realistic object collisions and height adjustments.

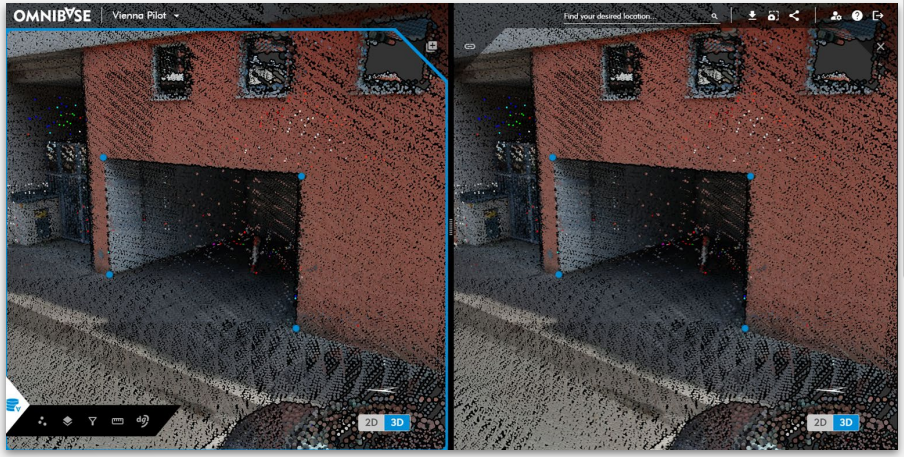
Results and Conclusion

User Experience Survey

Participants

Experienced users &

Non-experienced users



Procedure

VR and Omnibase multiview

Navigating & measuring

Geodelta. *Omnibase Software. 2024.* https://www.geodelta.com/en/software/omnibase

Results

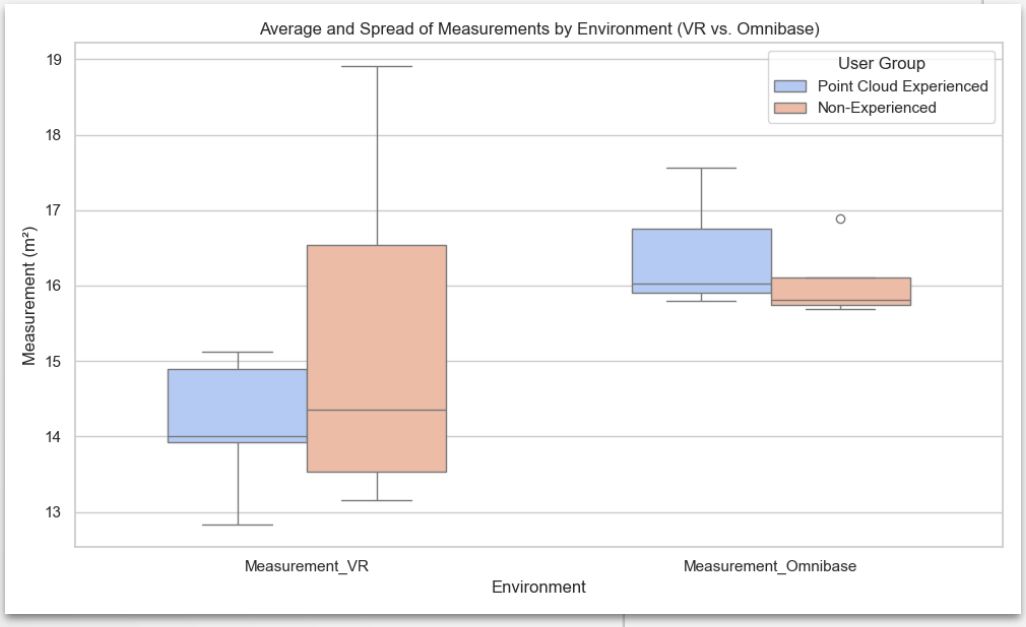
Non Experienced

- Wider spread of measurements in VR

Experienced

- Consistent measurements in Omnibase and VR due to familiarity
- Quick adaptation to both environments

- Larger measurements in Omnibase due to missing depth cues



Suggestions Add snap-to-points, measurement storage, user guide, enhanced menu

Conclusions

VR provides immersive depth cues and feels more natural

Physical drawbacks like dizziness

Longer learning curve for new users

Traditional controls are more familiar

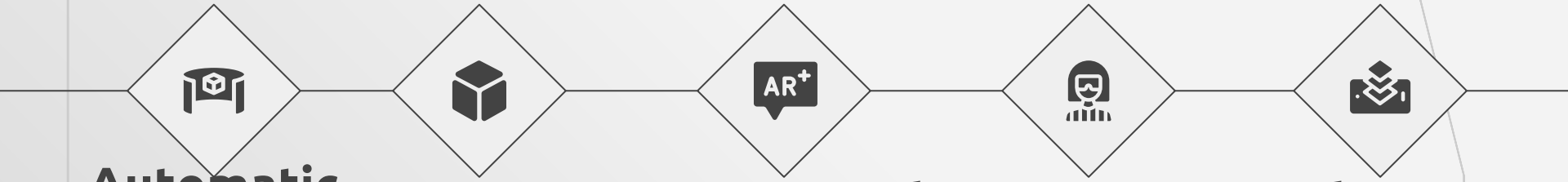
Implications in Practise

Make point clouds easier to understand and explore.

Enhance communication of geospatial information through immersive visualization.

GitHub

Future Work


Automatic Segmentation
Dynamic Detection
Augmented Reality
Long Term Studies
Indoor to Outdoor

Thanks!

Do you have any questions?

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