

Thermal Interaction in Spatial Augmented Reality

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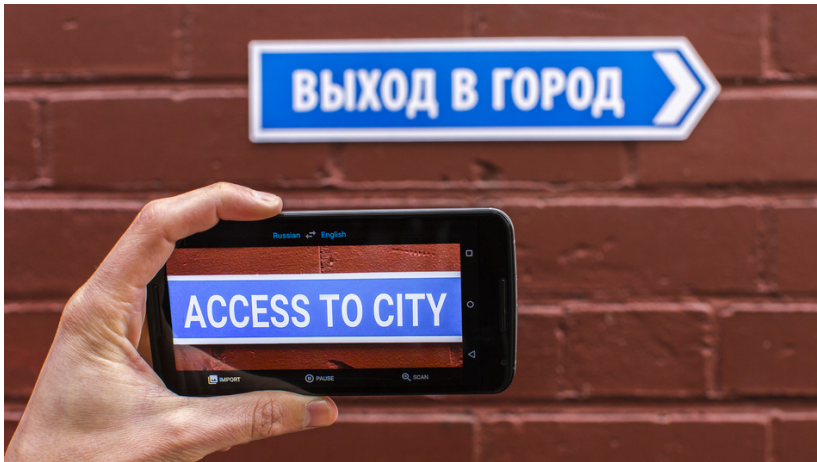
Background

- ▶ Virtual Reality
- ▶ Augmented Reality
- ▶ Spatial Augmented Reality
- ▶ 6DOF

Virtual Reality

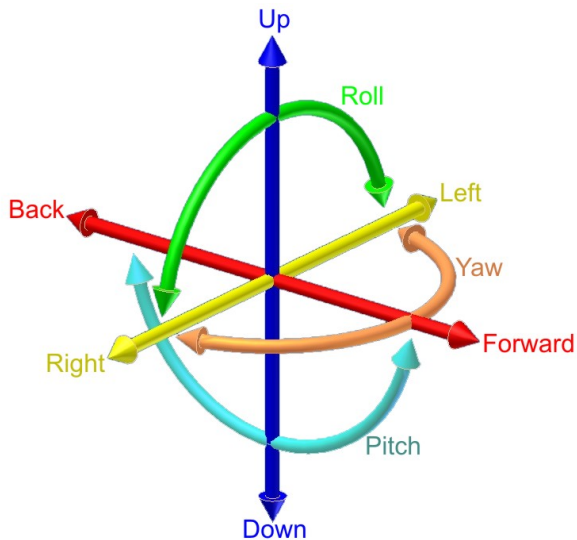
- ▶ Completely Virtual
- ▶ The Matrix
- ▶ Oculus Rift

Augmented Reality



Spatial Augmented Reality

6DOF



Outline

Thermal interaction with mobile devices

Using spatial augmented reality for 3D data visualization

Conclusions

Outline

Thermal interaction with mobile devices

- Hardware

- Thermal Detection

- Object Tracking

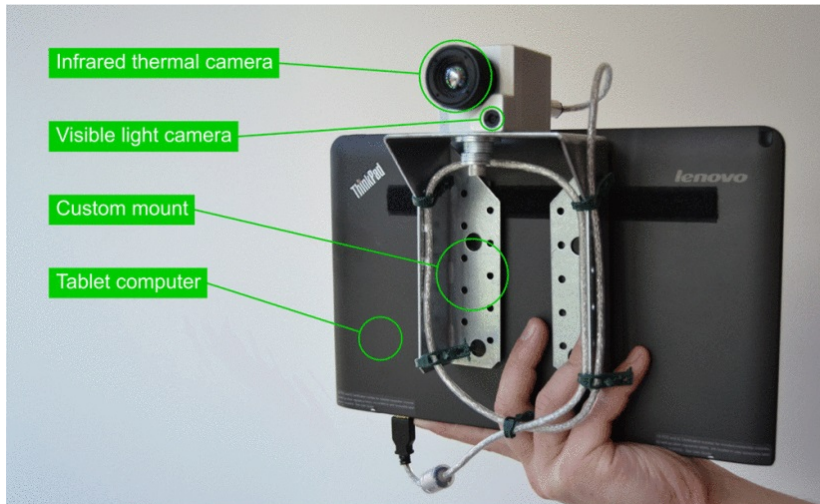
- Materials Tested

- Applications

Using spatial augmented reality for 3D data visualization

Conclusions

Hardware



Thermal Detection

- ▶ Assumes a controlled environment
- ▶ Object-only, hand-only, obstruction-by-hand, and touch-by-hand
- ▶ Interactions leave thermal impressions on the object
- ▶ Using the OpenCV SimpleBlobDetector

OpenCV SimpleBlobDetector

$$t_1 = (1 - \frac{1}{16})t_{min} + \frac{1}{16}t_{max} \quad t_2 = (1 - \frac{3}{8})t_{min} + \frac{3}{8}t_{max}$$

- ▶ t_1 and t_2 is the expected temperature range of the interaction
- ▶ With a fixed size range of $0.32cm^2$ and $1.54cm^2$

Object Tracking

- ▶ Metaio software



Materials Tested

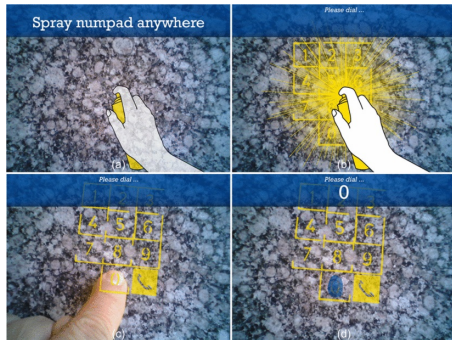
Applications

Applications that use thermal imaging with mobile technology

- ▶ "Spray on" graphical user interfaces (GUI)
- ▶ Augmented floor plans

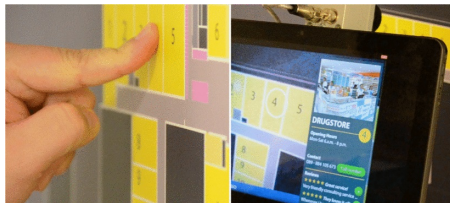
"Spray on" GUIs

- ▶ The screen displays a dial pad, but there is no dial pad on the surface
- ▶ Looking at the screen to interact with dial pad
- ▶ Devices without touch screens



Augmented Floor Plans

- ▶ Similar interaction, different interface
- ▶ Using number sections as buttons



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Using spatial augmented reality for 3D data visualization

Visualizing Data

Applications

Limitations

Conclusions

Visualizing Data

- ▶ Representing data visually
- ▶ Examples: weather maps, pie and bar charts, etc
- ▶ The importance of visualizing data

Applications

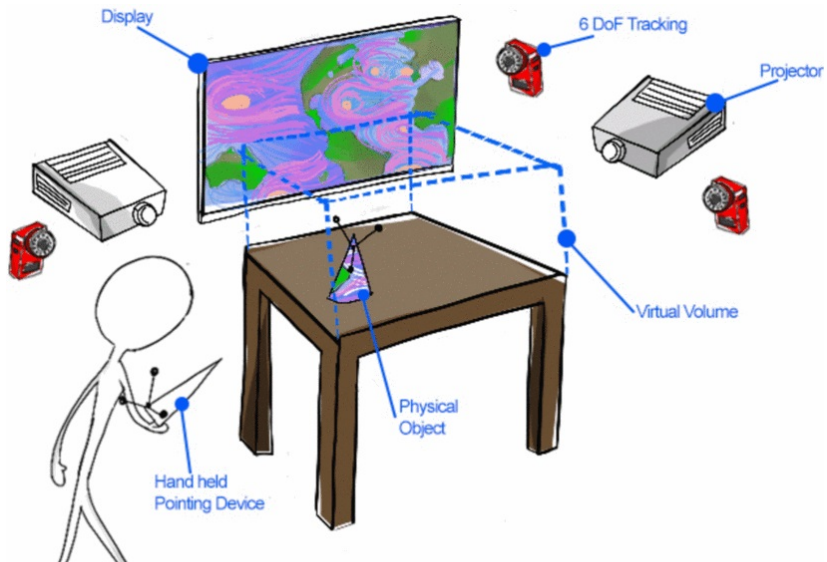
Applications that use spatial augmented reality for 3D data visualization

- ▶ Table-Top
- ▶ CAVE

Table-Top

- ▶ Using a hand held pointing device a user can zoom in or out of the visualization
- ▶ The interactions happen inside the virtual volume

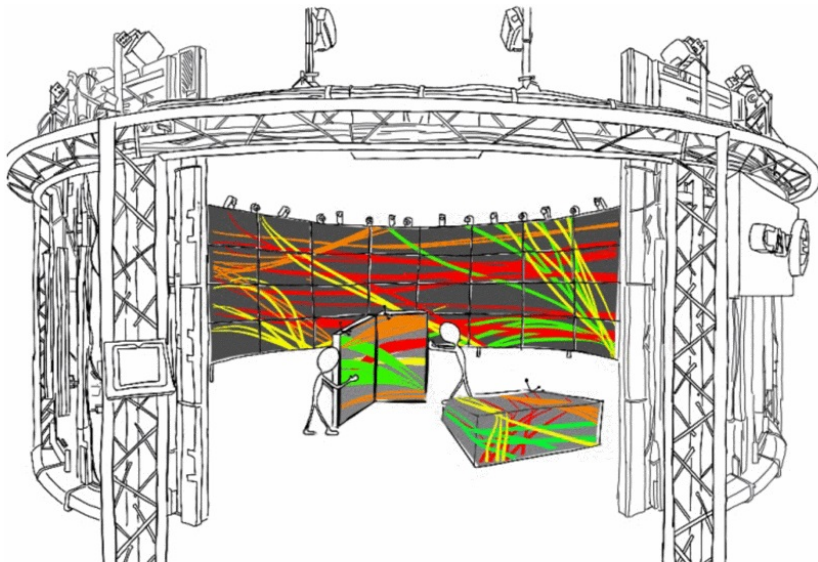
Table-Top



CAVE

- ▶ Larger area than the table-top method
- ▶ Increase in collaborators/viewers
- ▶ Similar interactions as the table-top method

CAVE



Limitations

- ▶ Strength of the projectors
- ▶ Needing a controlled environment
- ▶ Solutions

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Conclusions



Thanks!

Thank you for your time and attention!

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Any Questions?