

Thermal Interaction in Spatial Augmented Reality

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5 December 2015

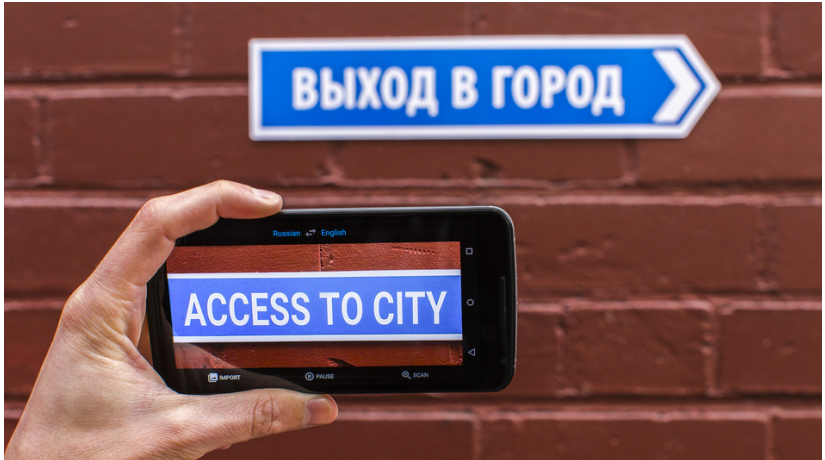
Background

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

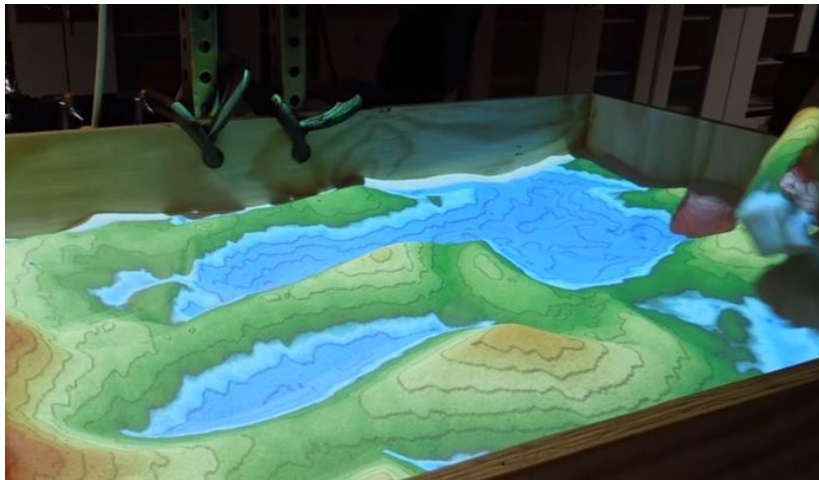
Virtual Reality

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

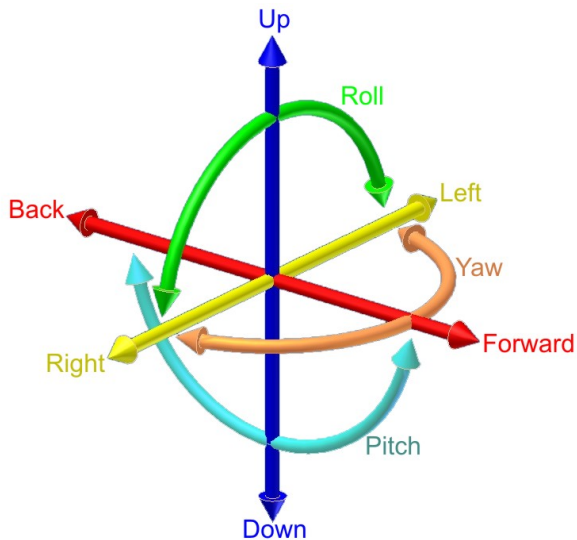
Augmented Reality



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

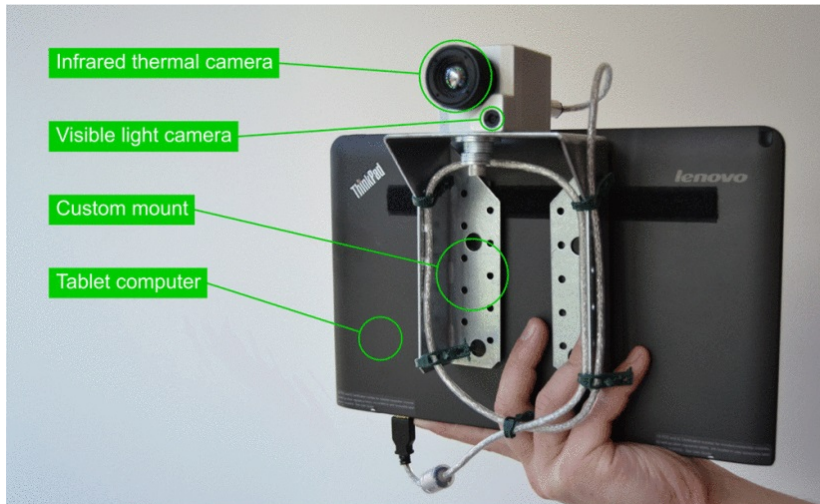
Object Tracking

Applications

Using spatial augmented reality for 3D data visualization

Conclusions

Hardware



Thermal Detection

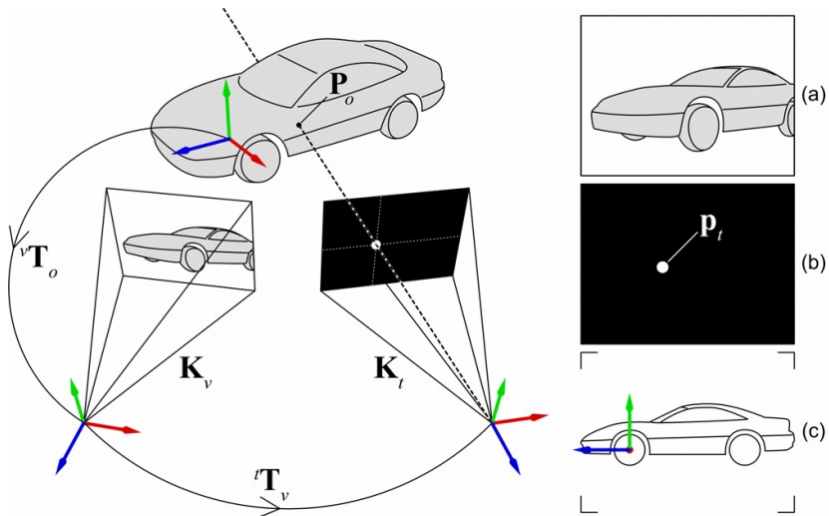
- ▶ Assumes a controlled environment
- ▶ Object-only, hand-only, obstruction-by-hand, and touch-by-hand
- ▶ Interactions leave thermal impressions on the object
- ▶ Using the OpenCV SimpleBlobDetector

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



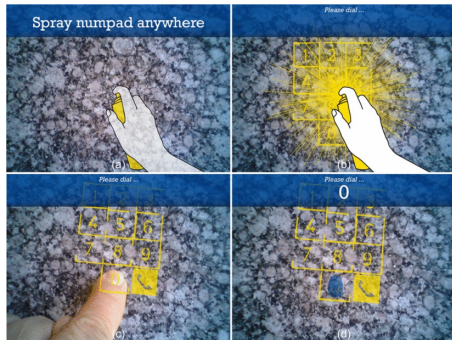
Applications

Applications that use thermal imaging with mobile technology

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

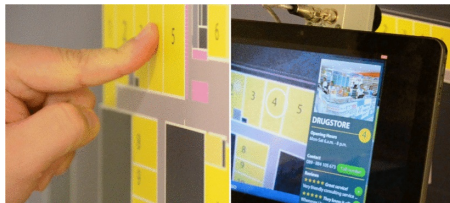
"Spray on" GUIs

- ▶ 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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Visualizing Data

Applications

Limitations

Conclusions

Visualizing Data

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

Applications

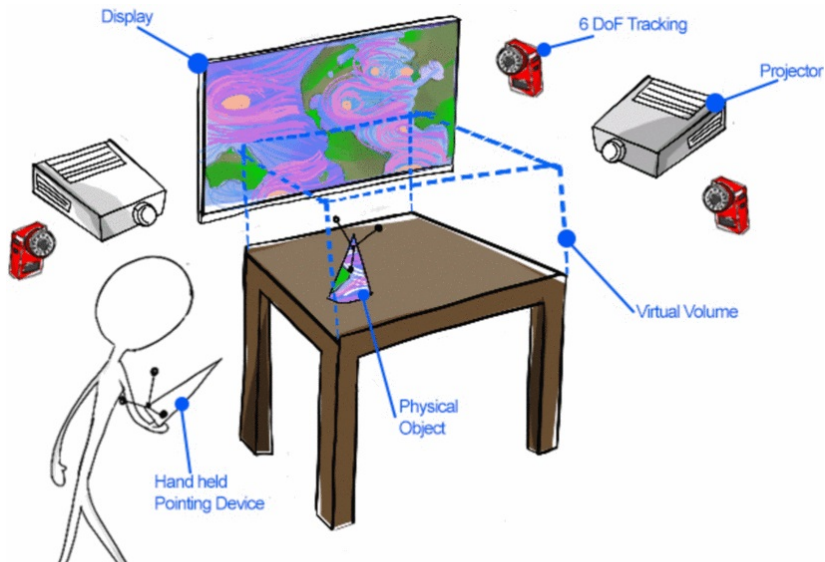
Applications that use spatial augmented reality for 3D data visualization

- ▶ 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

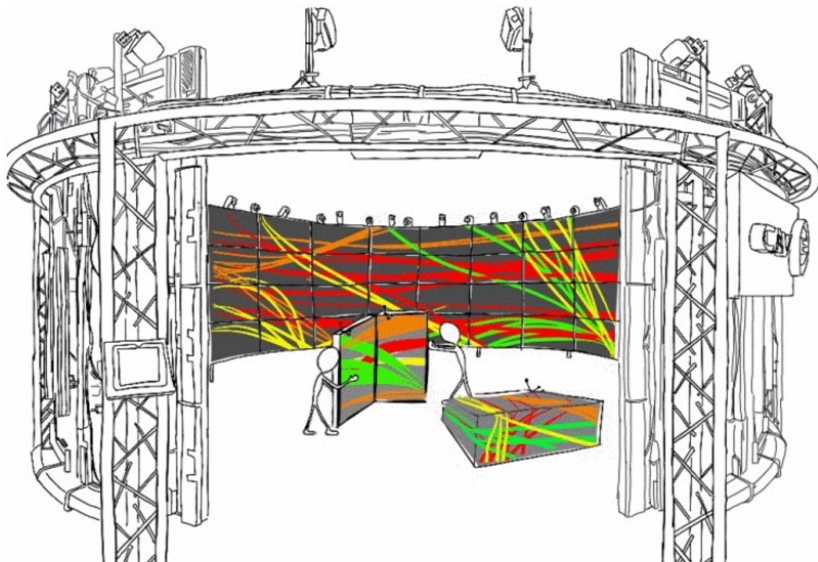
Table-Top



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

- ▶ Utilizing both of these approaches would make new applications possible
- ▶ Examples: education and transportation

Thanks!

Thank you for your time and attention!

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Any Questions?