Thermal Interaction in Spatial Augmented Reality

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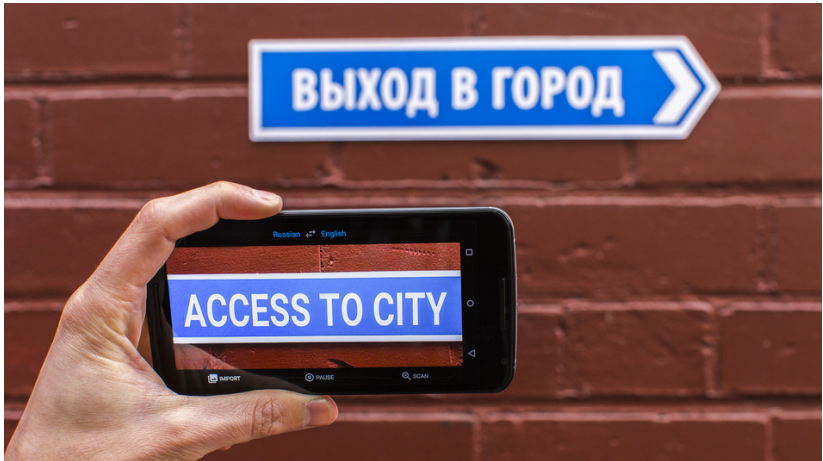Morris, Minnesota, USA

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Background

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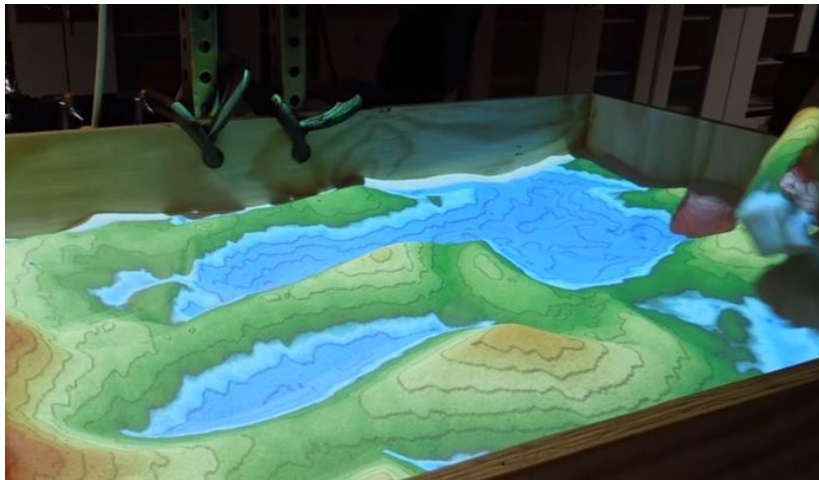- Augmented Reality
- Spatial Augmented Reality
- 6DOF

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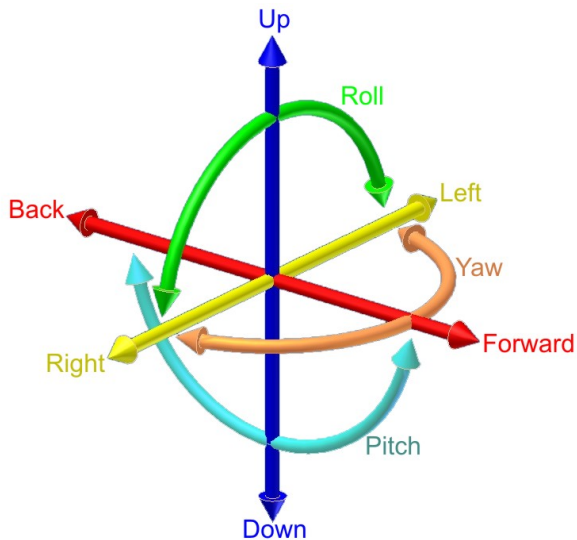
- ▶ Completely Virtual
- ▶ The Matrix
- ▶ Oculus Rift

Augmented Reality

Spatial Augmented Reality

6DOF

Outline

Thermal interaction with mobile devices

Using spatial augmented reality for 3D data visualization

Conclusions

Outline

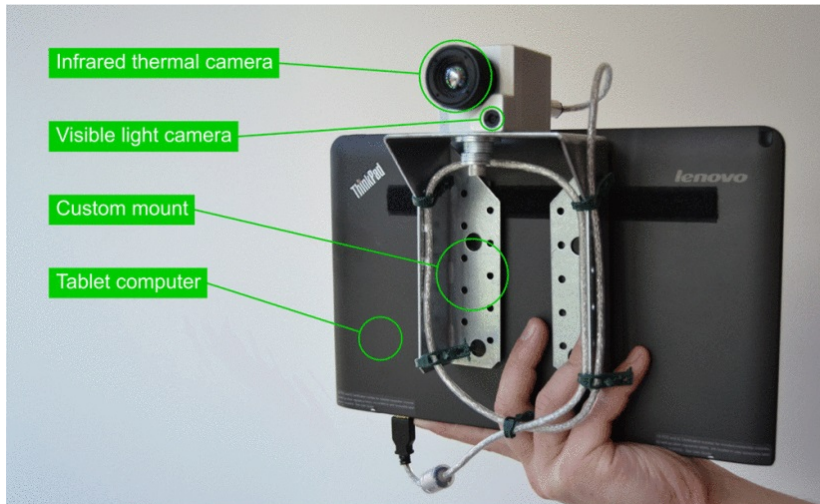Thermal interaction with mobile devices
  Hardware
  Thermal Detection
  Object Tracking
  Applications

Using spatial augmented reality for 3D data visualization

Conclusions

Hardware

Infrared thermal camera

Visible light camera

Custom mount

Tablet computer

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

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

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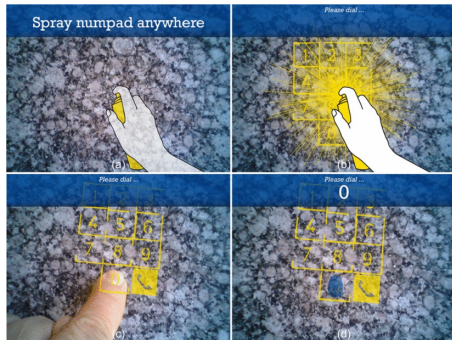
Object Tracking
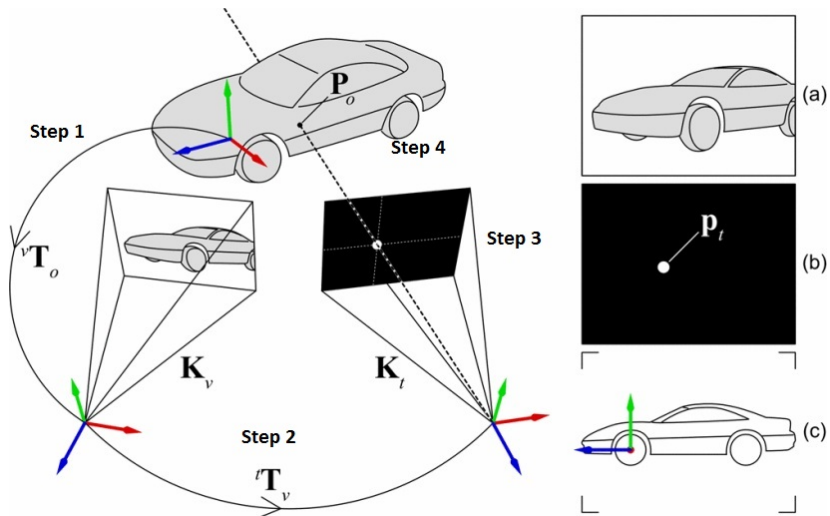
Applications

Applications that use thermal imaging with mobile technology

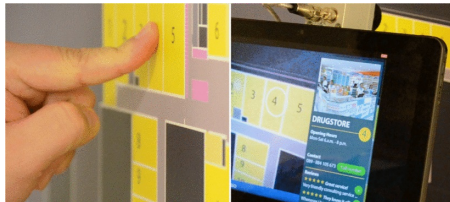- ▶ "Spray on" graphical user interfaces (GUI)
- ▶ Augmented floor plans

"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

Outline

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
- Interactions happen inside the virtual volume

Table-Top

- ▶ Physical object represents the 3D space
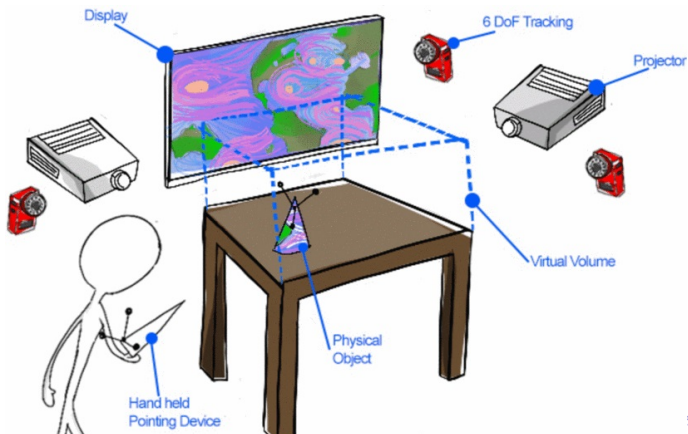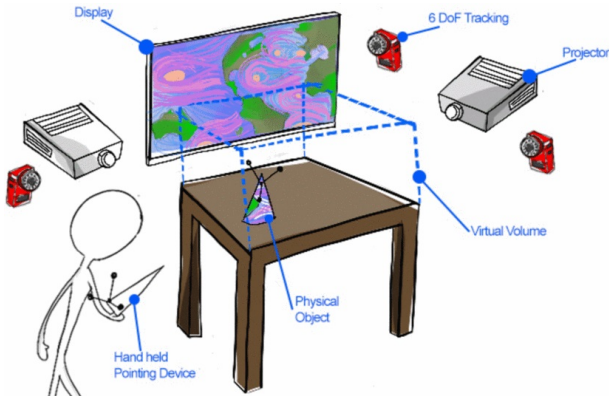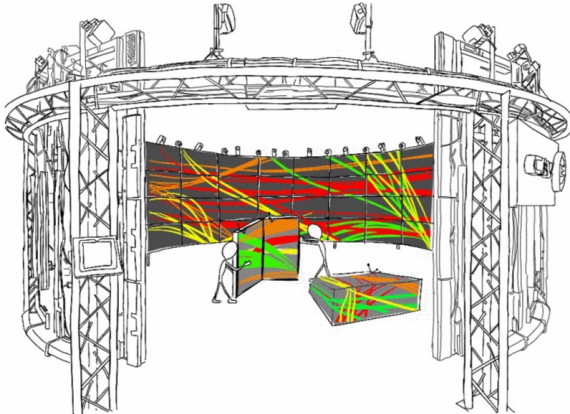- ▶ The display is a 2D representation of the 3D space

Table-Top

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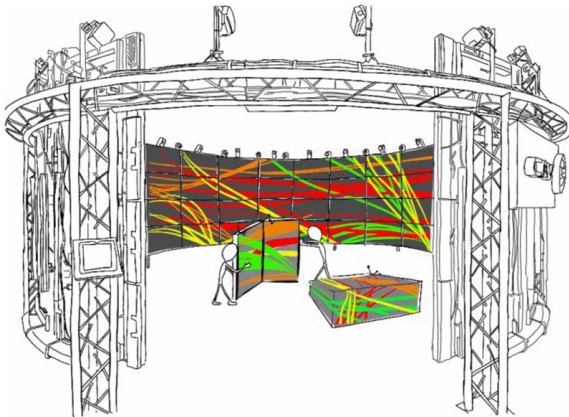- ▶ Interactions happen inside the virtual volume

CAVE

- ▶ CAVE - Cave Automatic Virtual Environment
- ▶ Larger area than the table-top method

CAVE

- ► Increase in collaborators/viewers
- ► Similar interactions as the table-top method

Limitations

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

Outline

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?