

Thermal Interaction & 3D Data Visualization

Justin Brennen YaDeau

Division of Science and Mathematics
University of Minnesota, Morris
Morris, Minnesota, USA

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- ▶ What would thermal interaction & 3D data visualization look like?

Outline

Background

Thermal interaction with mobile devices

Using spatial augmented reality for 3D data visualization

Conclusions

Outline

Background

Virtual Reality

Augmented Reality

Spatial Augmented Reality

6DOF

Thermal interaction with mobile devices

Using spatial augmented reality for 3D data visualization

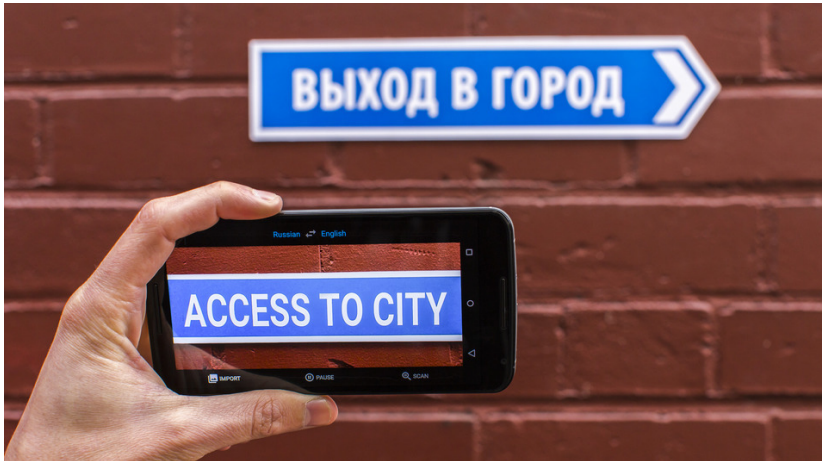
Conclusions

Virtual Reality

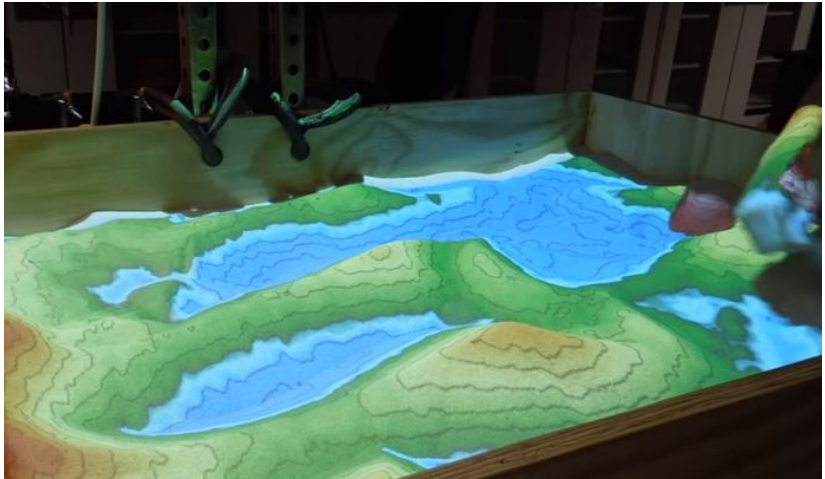
- ▶ Completely Virtual
- ▶ The Matrix
- ▶ Oculus Rift



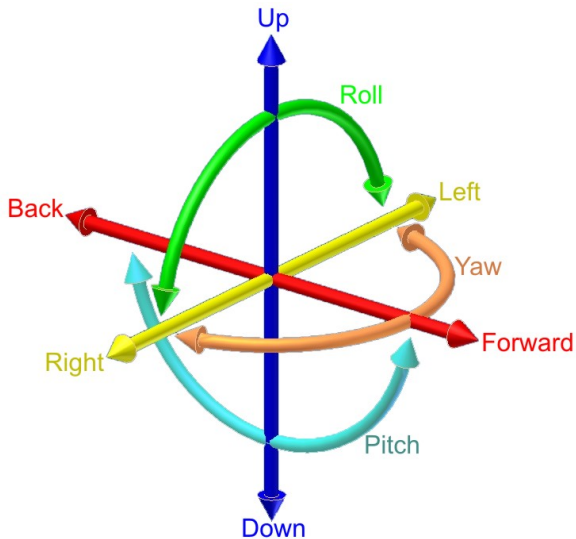
Augmented Reality



Spatial Augmented Reality



6DOF



Outline

Background

Thermal interaction with mobile devices

- Interacting with Objects

- Hardware

- Thermal Detection

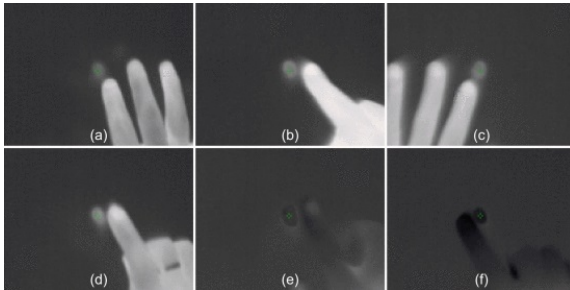
- Object Tracking

- Applications

Using spatial augmented reality for 3D data visualization

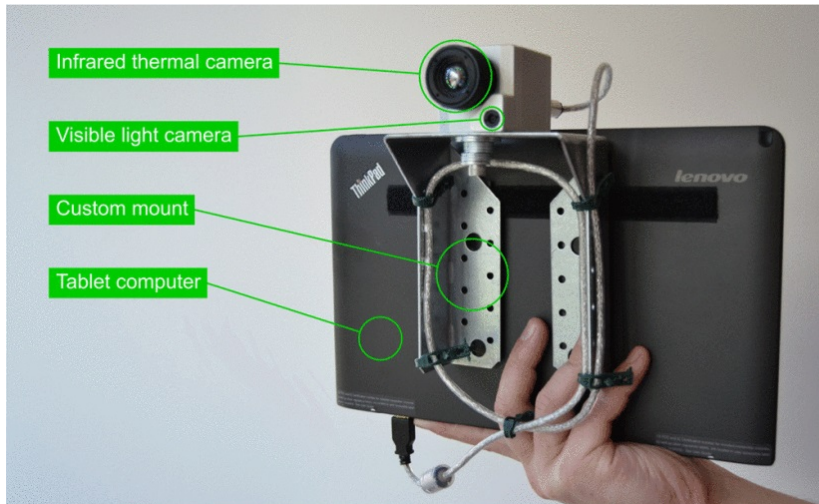
Conclusions

Interactions with Objects



- ▶ Interactions leave thermal impressions on the object
- ▶ Using these impressions to interact with a device in a new way

Hardware



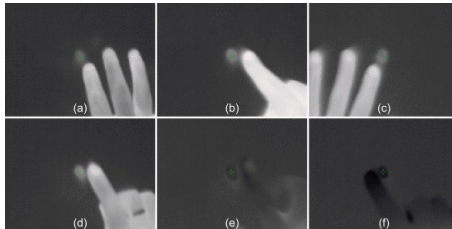
Thermal Detection

- ▶ Assumes a controlled environment
- ▶ Object-only, hand-only, obstruction-by-hand, and touch-by-hand
- ▶ Using the OpenCV SimpleBlobDetector

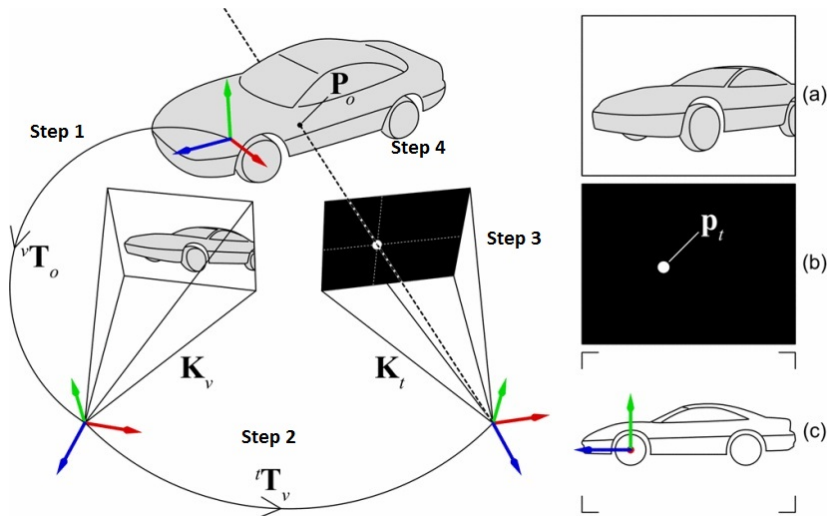
OpenCV SimpleBlobDetector

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

- ▶ 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



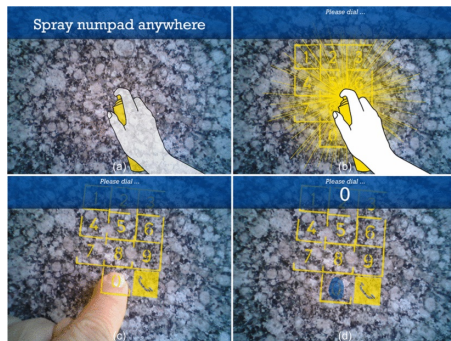
Applications

Some applications that use thermal imaging with mobile technology

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

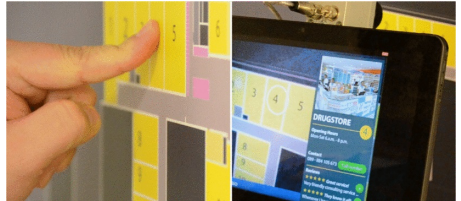
"Spray on" GUIs

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

Applications

Some applications that use spatial augmented reality for 3D data visualization

- ▶ Table-Top
- ▶ CAVE

Table-Top

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

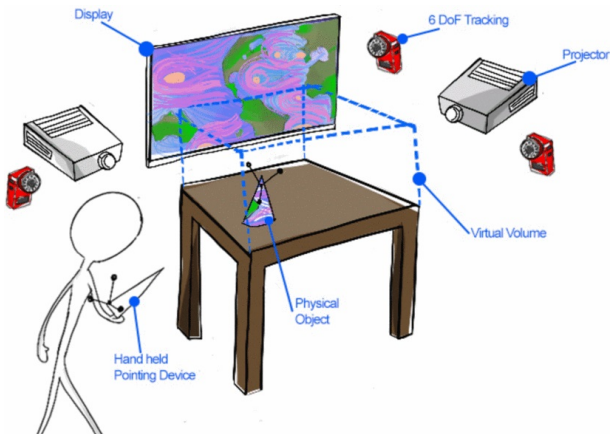
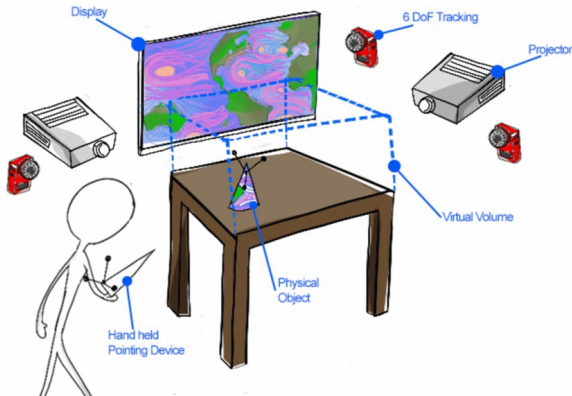


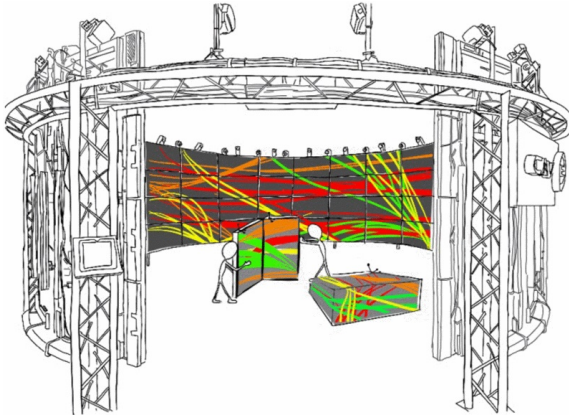
Table-Top

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



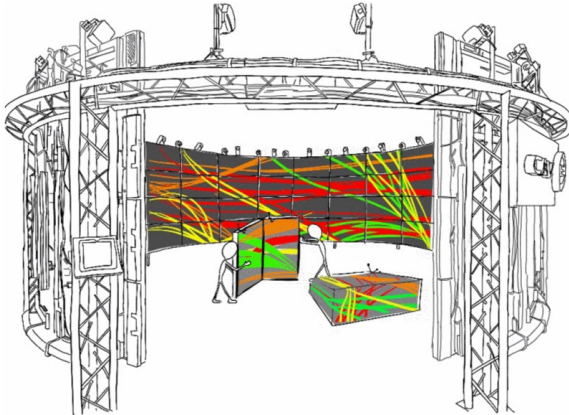
CAVE

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



CAVE

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



Limitations

- ▶ Strength of the projectors
- ▶ Need for a controlled environment for projectors and 6DOF trackers
- ▶ Solution

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Conclusions

- ▶ Utilizing both thermal interaction and 3D data visualization new applications are possible
- ▶ Examples: education and transportation

Thanks!

Thank you for your time and attention!

Contact:

▶ `yadea003@morris.umn.edu`

Any Questions?