Thermal Interaction & 3D Data Visualization

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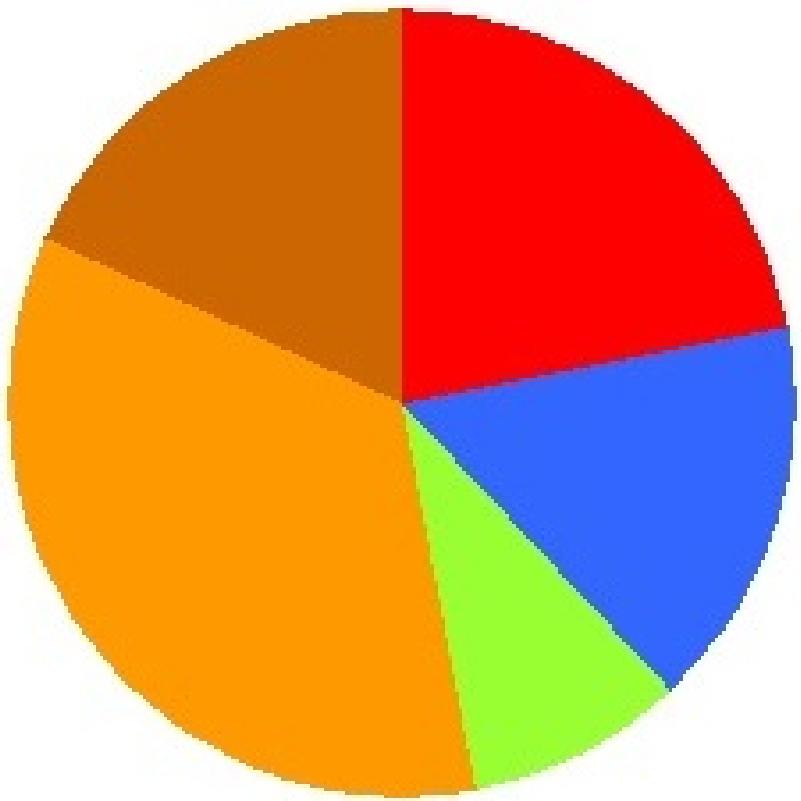
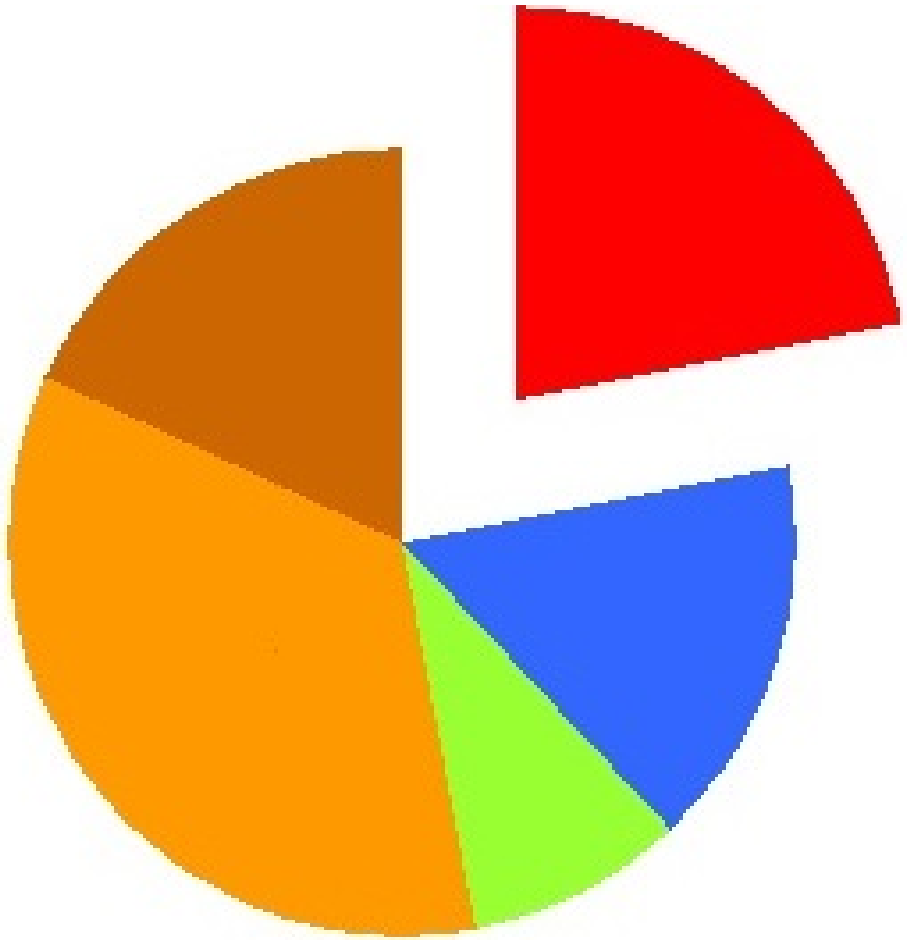
- What would thermal interaction & 3D data visualization look like?



https://goo.gl/yZr4BR



https://goo.gl/HXtvA3

Outline

Background

Thermal interaction with mobile devices

Using spatial augmented reality for 3D data visualization

Conclusions

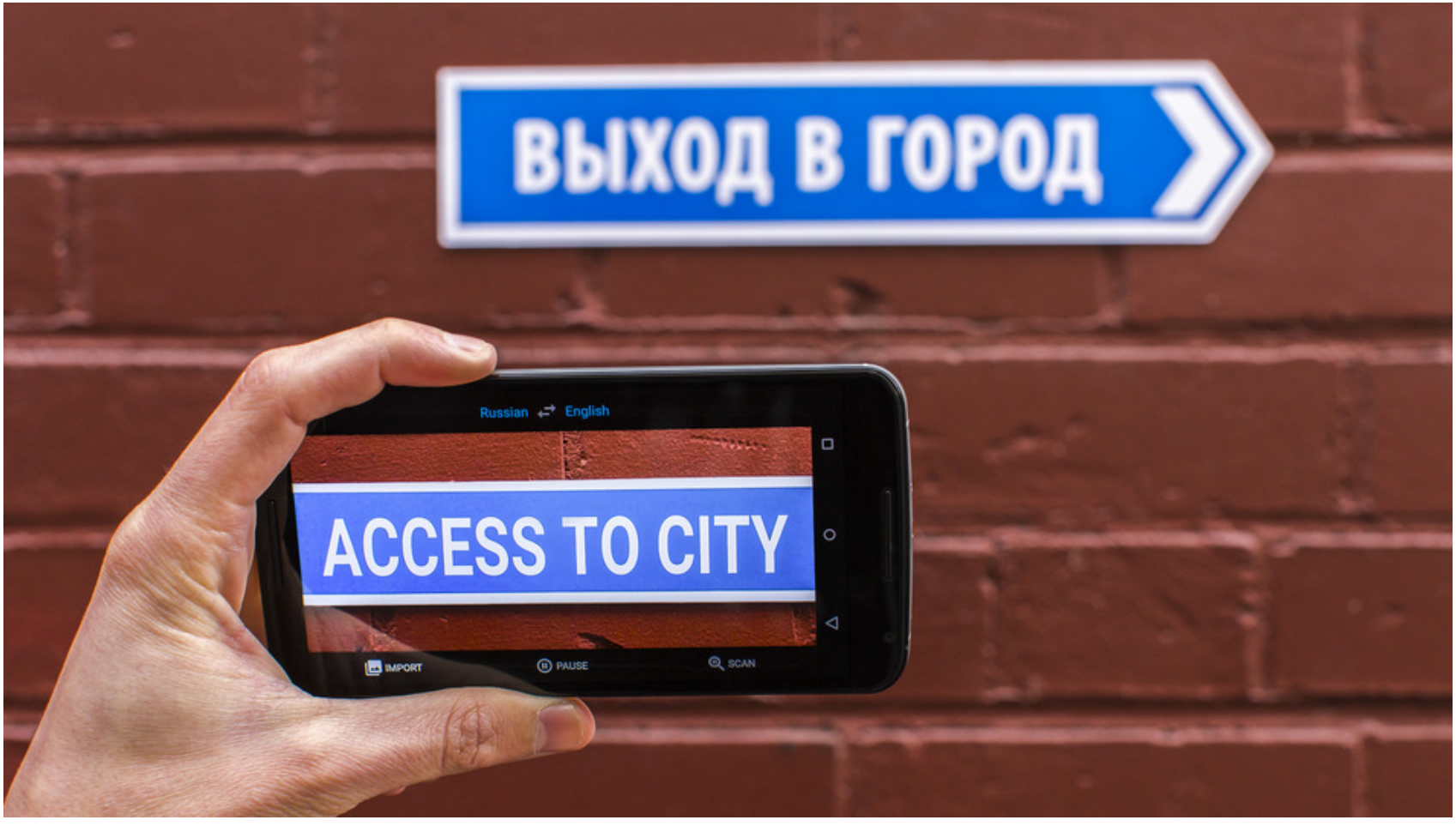
Outline

Virtual Reality

- Completely Virtual
- Oculus Rift

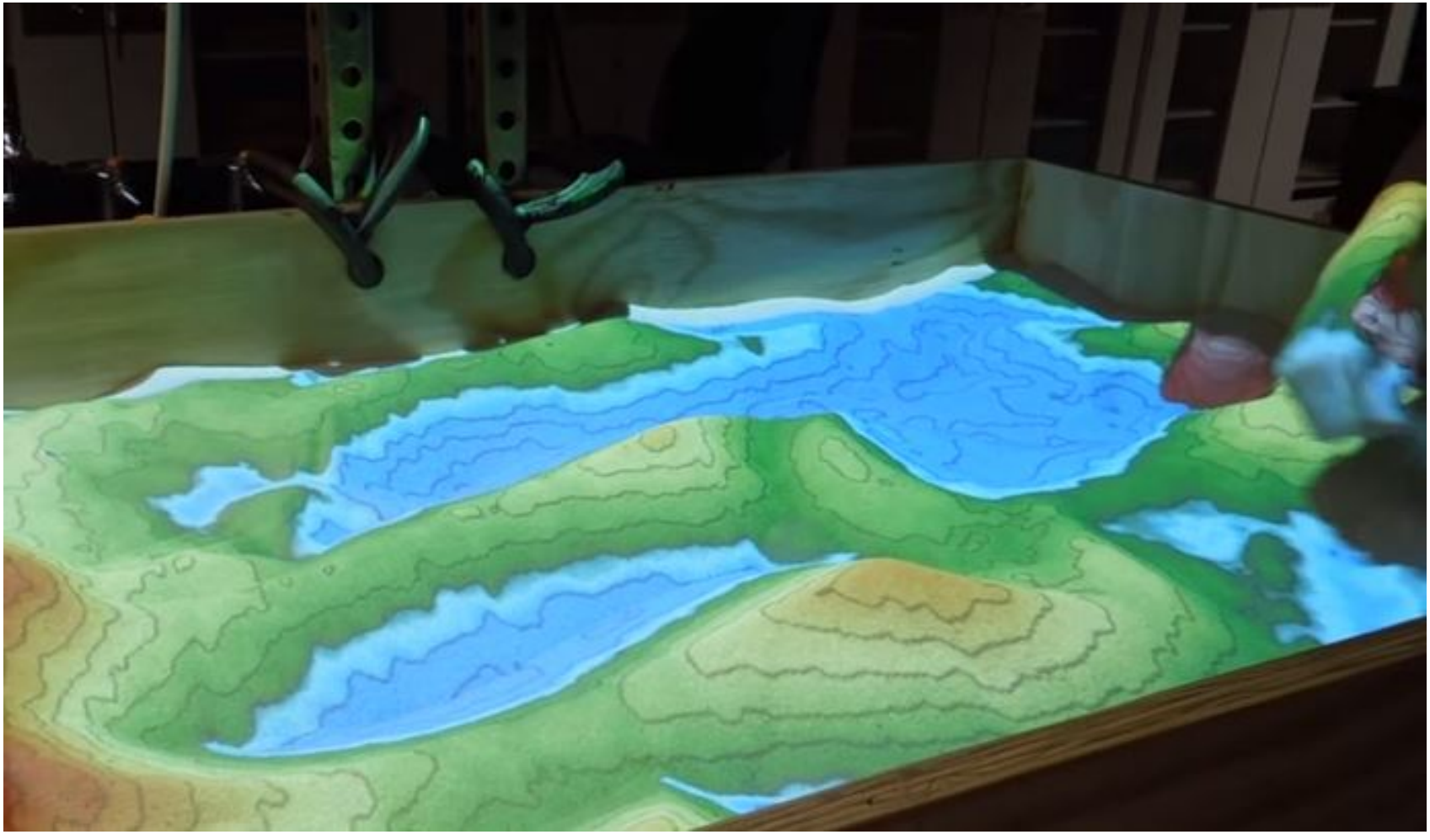
Top - http://goo.gl/nfUBv0
Bottom - http://goo.gl/t78Qvr

Augmented Reality



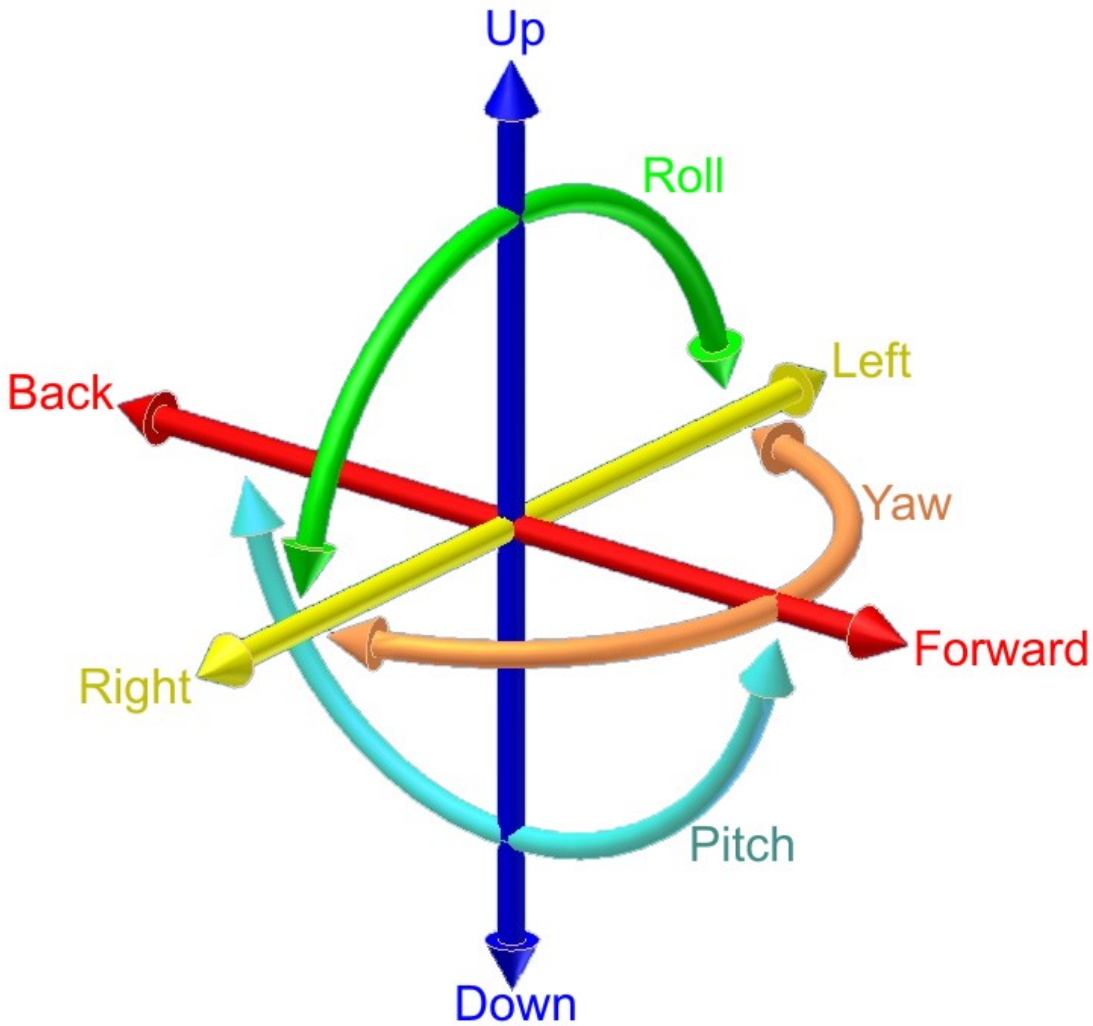
http://www.emergingedtech.com/2015/08/translate-language-text-on-the-fly-using-phone-google-translate-app/

Spatial Augmented Reality



http://peanutchuck.com/augmented-reality-sandbox/

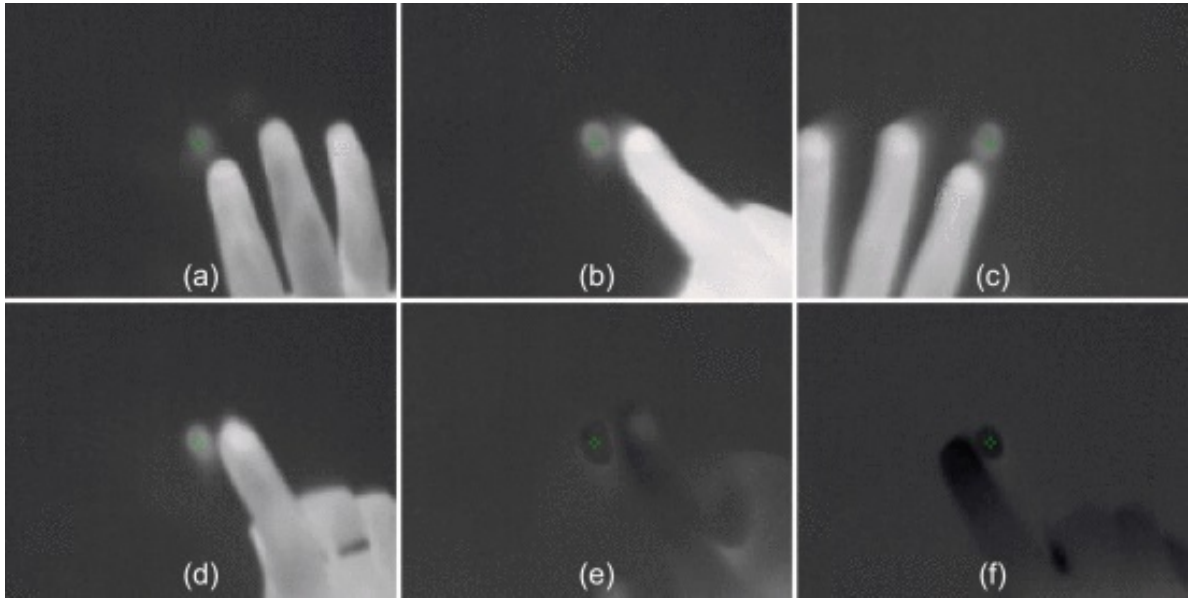
6DOF



[Wikipedia(2015)]

Outline

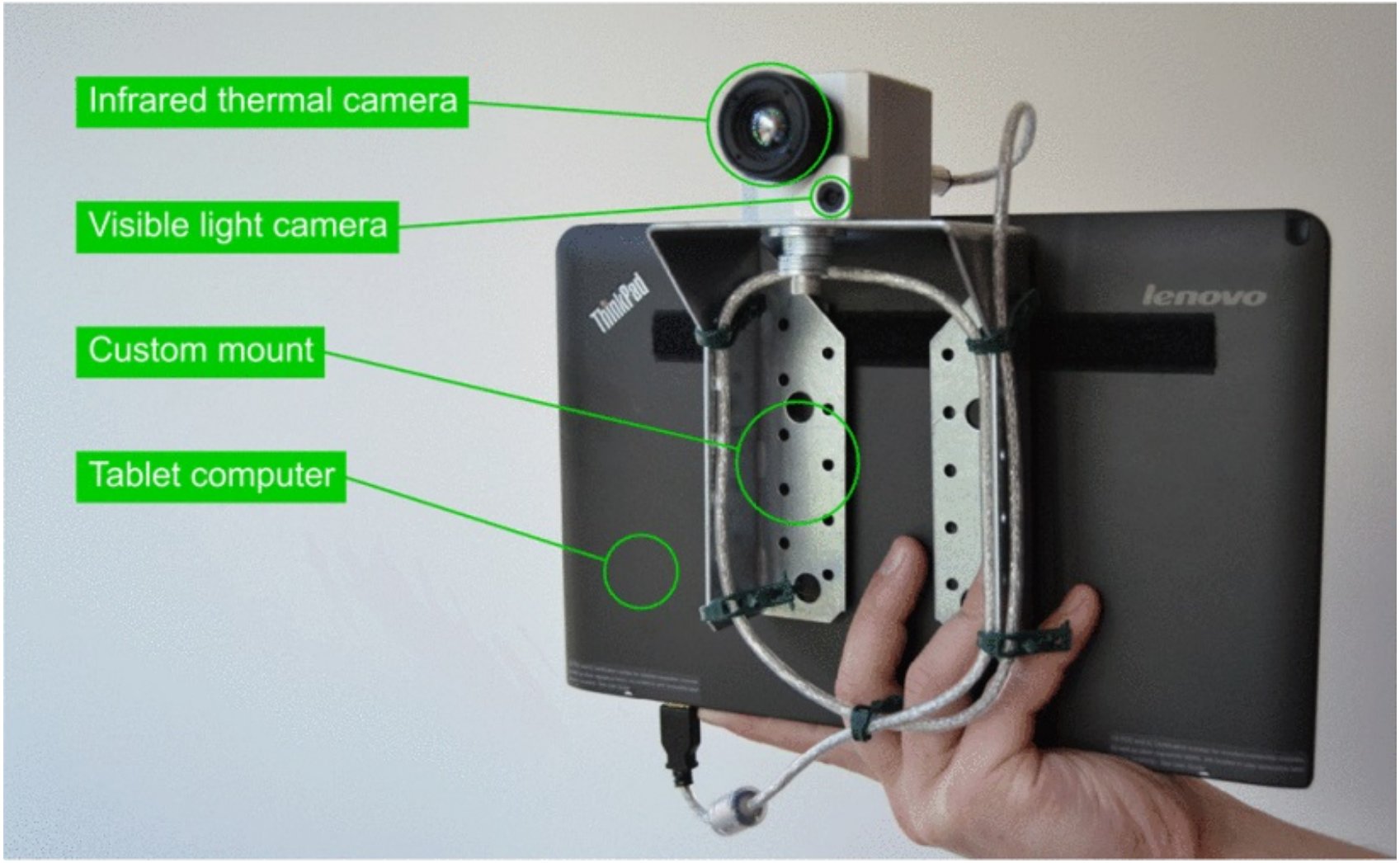
Interactions with Objects



[Kurz(2014)]

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

Hardware



[Kurz(2014)]

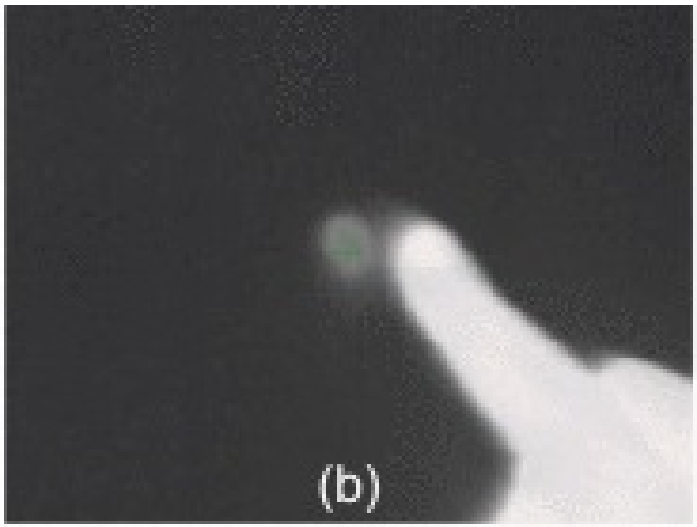
Thermal Detection

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

OpenCV SimpleBlobDetector

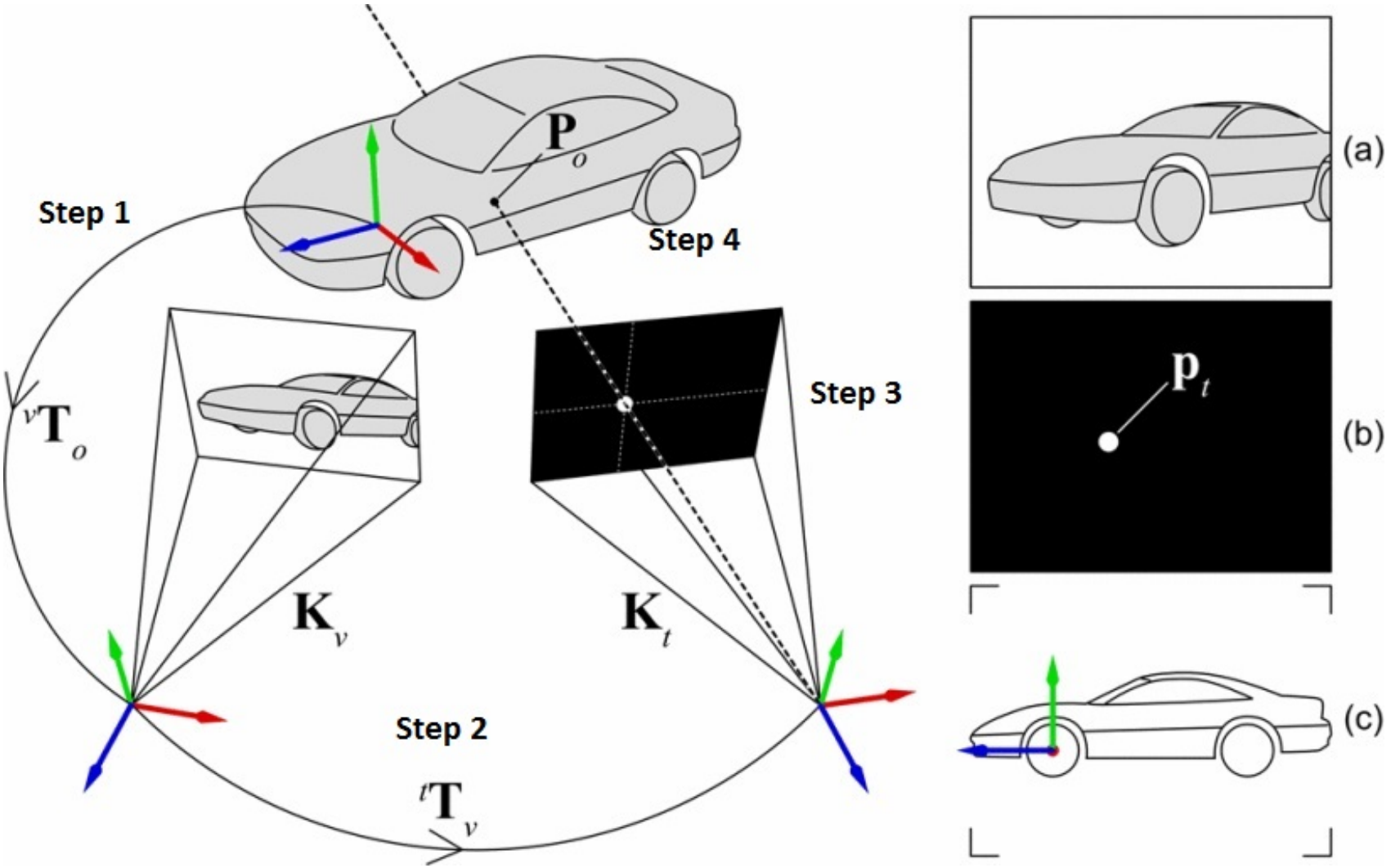
$$t_1 = (1 - \frac{1}{16})t_{min} + \frac{1}{16}t_{max} \quad t_2 = (1 - \frac{3}{8})t_{min} + \frac{3}{8}t_{max}$$

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



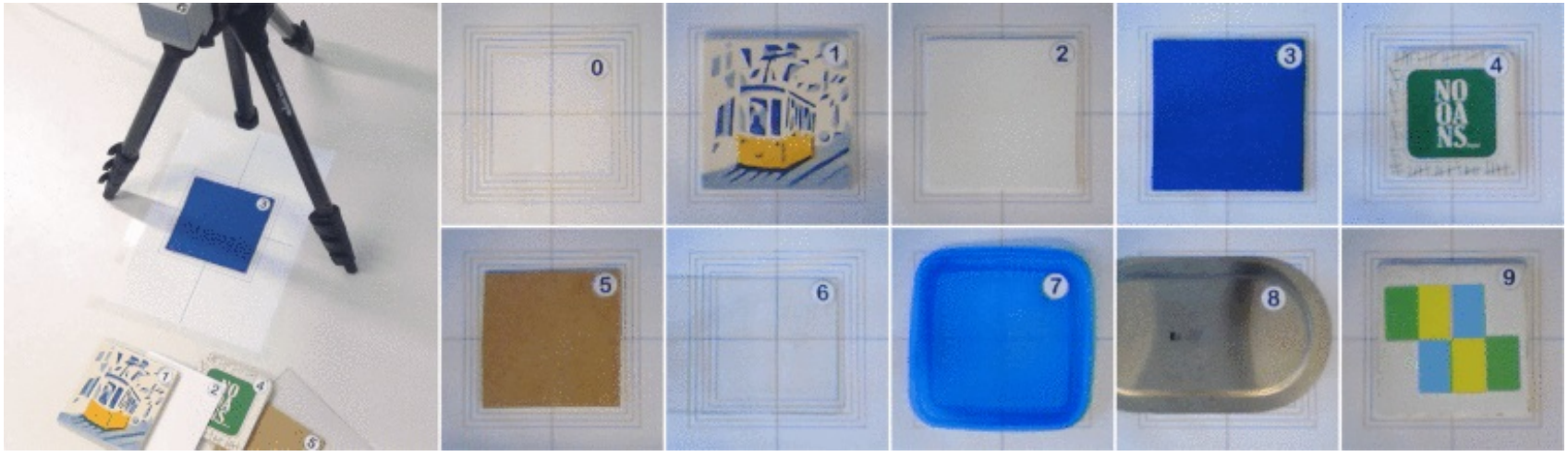
[Kurz(2014)]

Object Tracking



[Kurz(2014)]

Materials Tested



Different materials used during the evaluation: (0) paper on a plastic table-top, (1) ceramic, (2) rigid PVC, (3) foam plastic, (4) cardboard, (5) laminated fiber sheet, (6) glass, (7) thin plastic, (8) steel, (9) multi-layer board

[Kurz(2014)]

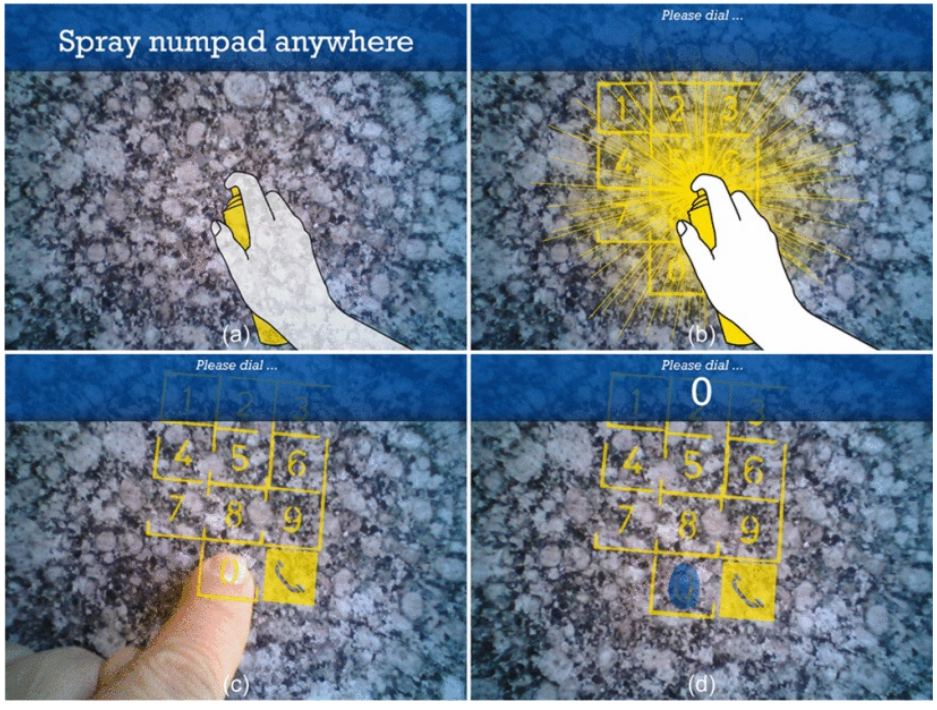
Applications

Some applications that use thermal imaging with mobile technology

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

"Spray on" GUIs

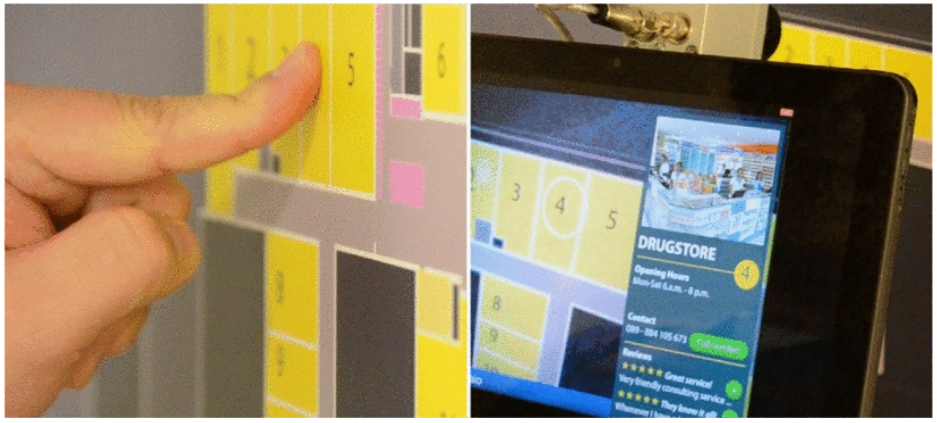
- The screen displays a dial pad, but there is no dial pad on the surface
- Looking at the screen to interact with dial pad
- Devices without touch screens



[Thomas(2014)]

Augmented Floor Plans

- Similar interaction, different interface



[Thomas(2014)]

Outline

Visualizing Data

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

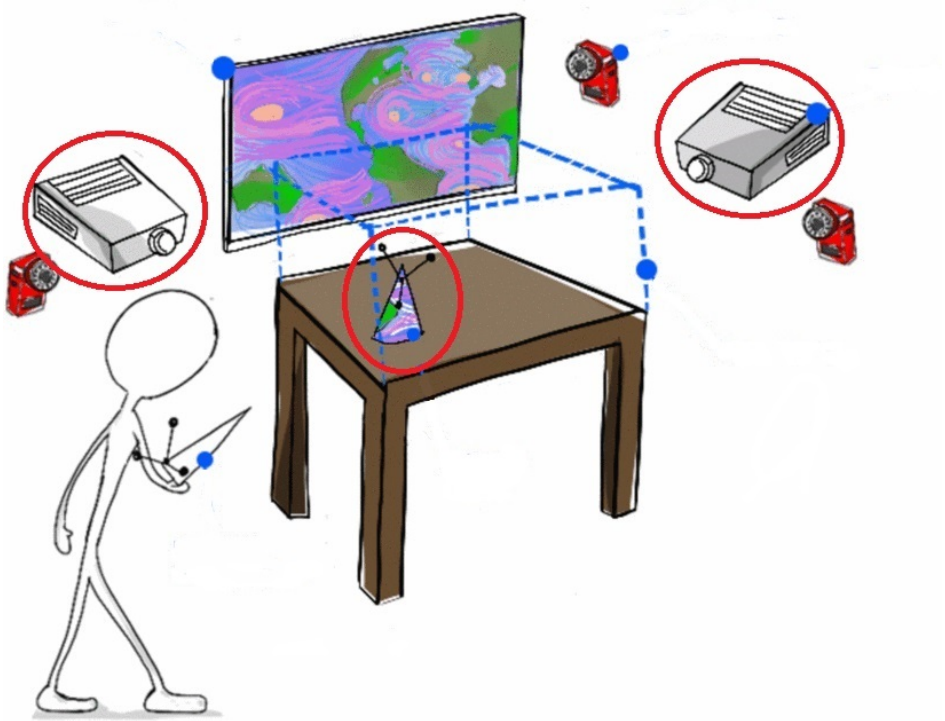
Applications

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
- 6DOF trackers



[Thomas(2014)]

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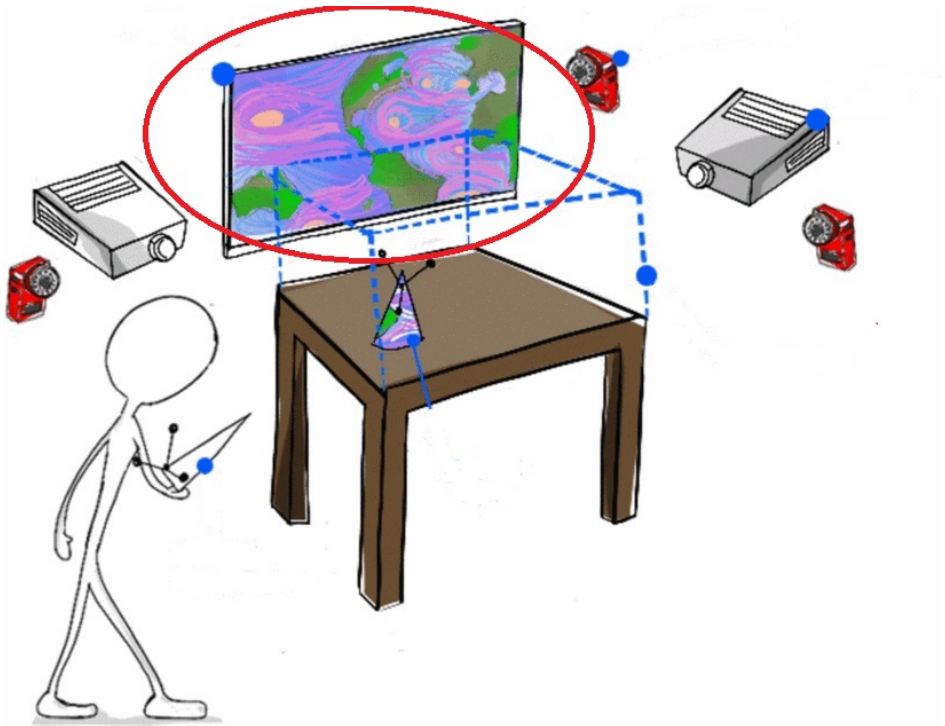

[Thomas(2014)]

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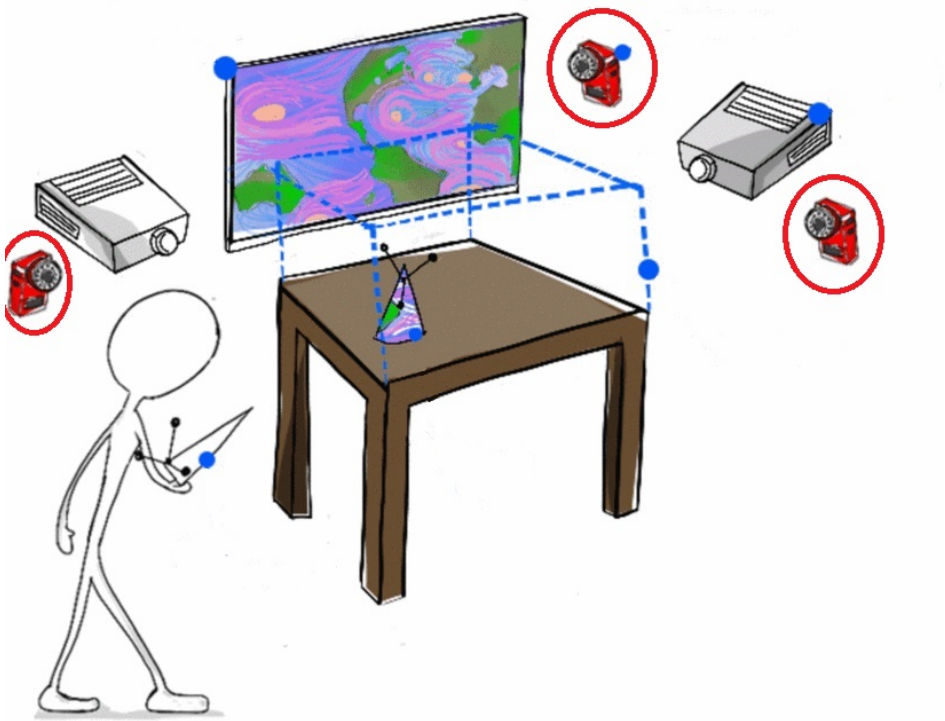
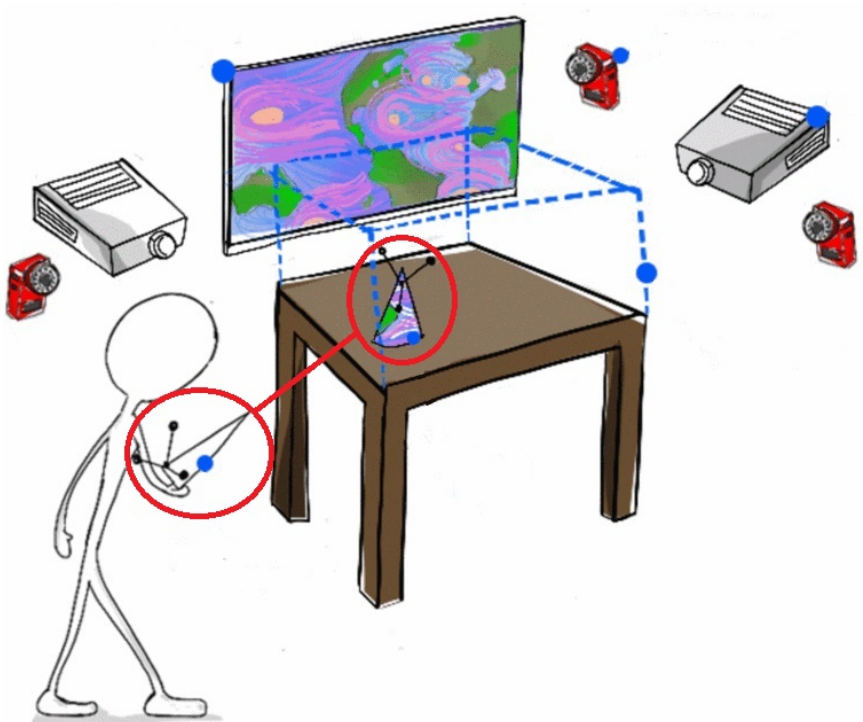


[Thomas(2014)]

Table-Top

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



[Thomas(2014)]

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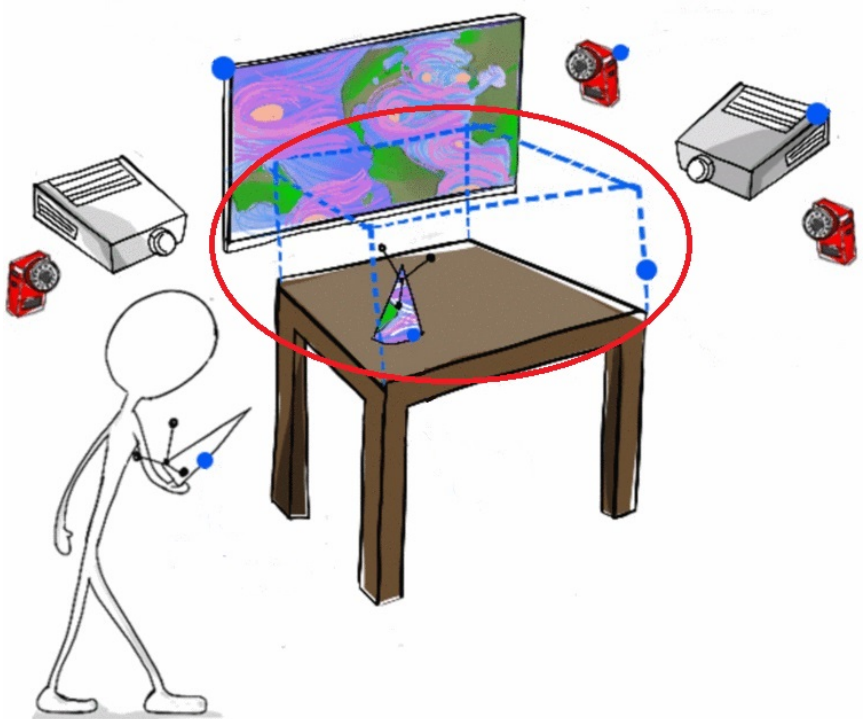
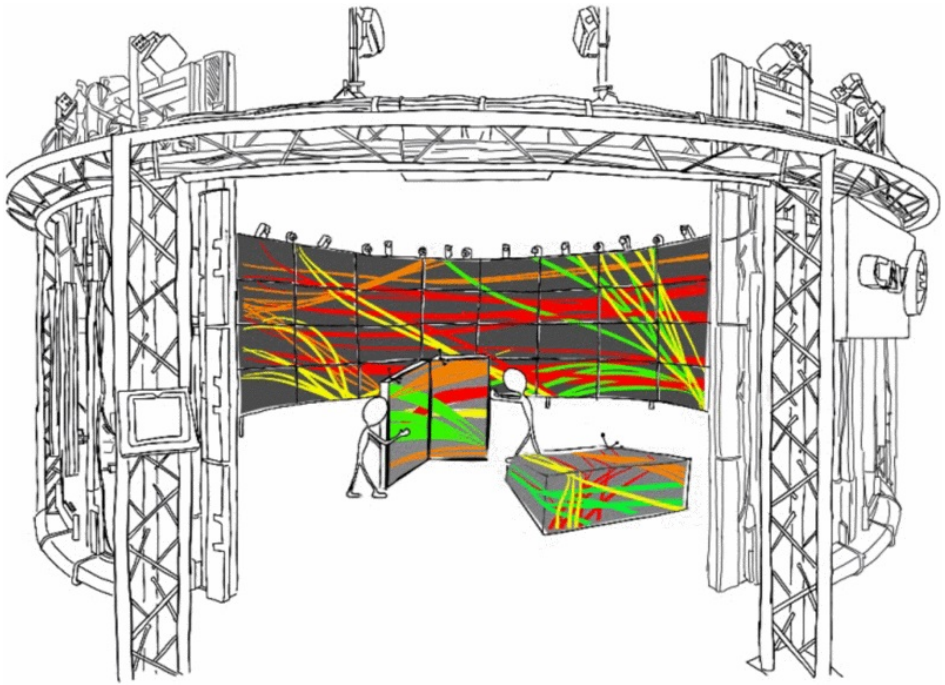


[Thomas(2014)]

CAVE

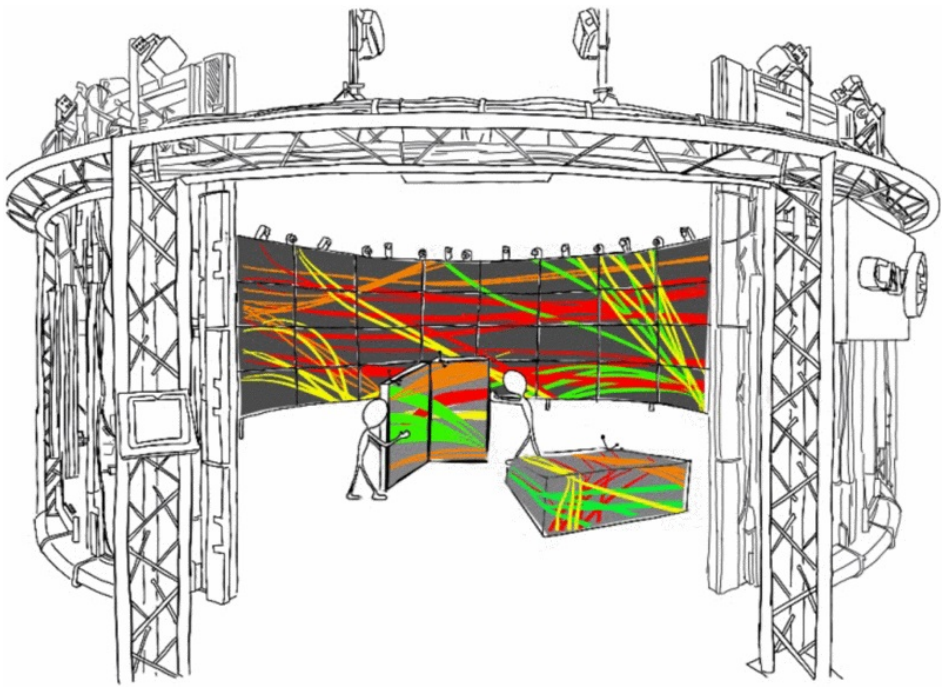
- CAVE - Cave Automatic Virtual Environment
- Larger area than the table-top method



[Thomas(2014)]

CAVE

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



[Thomas(2014)]

Limitations

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

Outline

Conclusions

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

Bibliography I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Thanks!

Thank you for your time and attention!

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Any Questions?