Thermal Interaction & 3D Data Visualization

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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

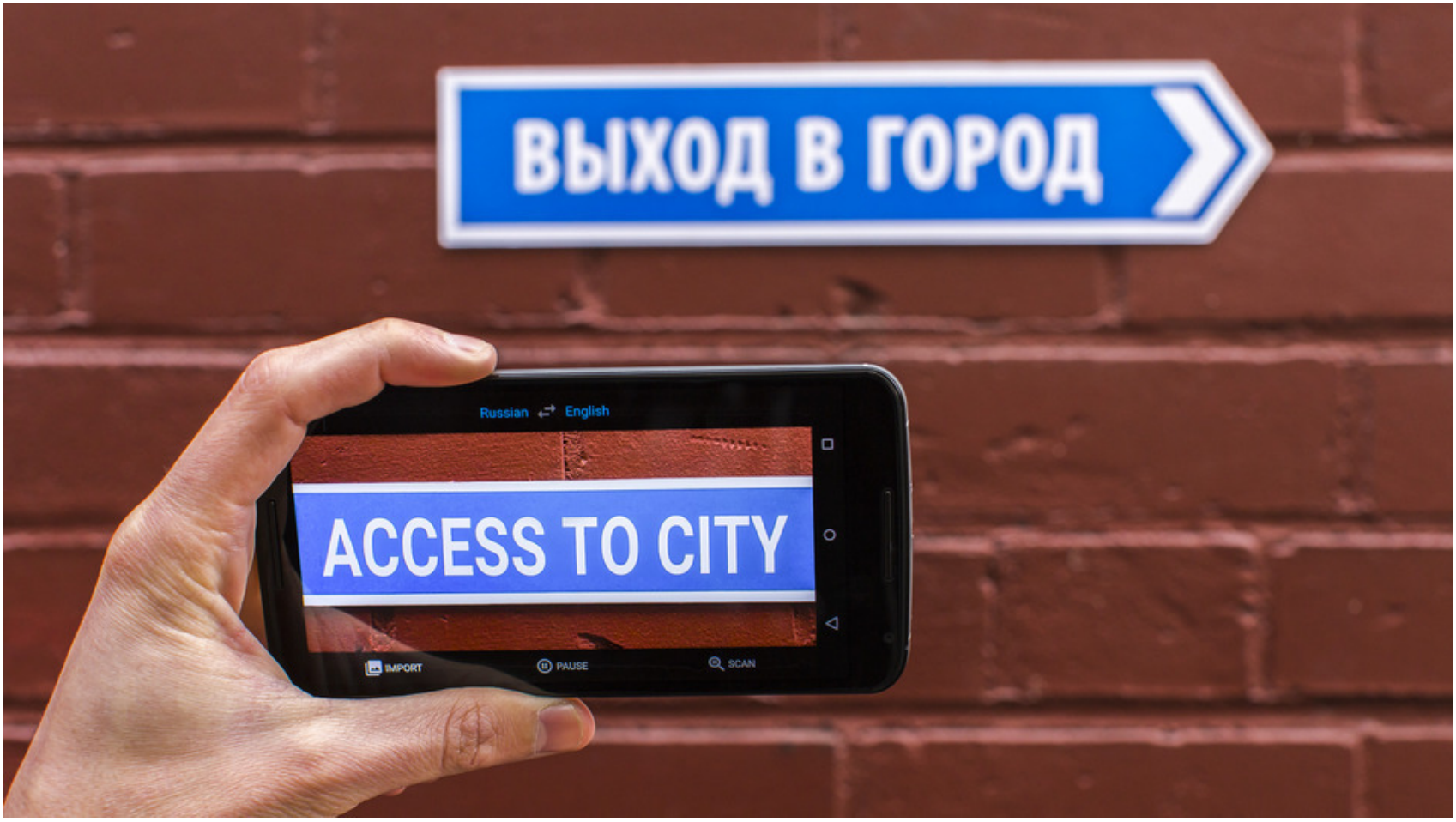
Conclusions

Outline

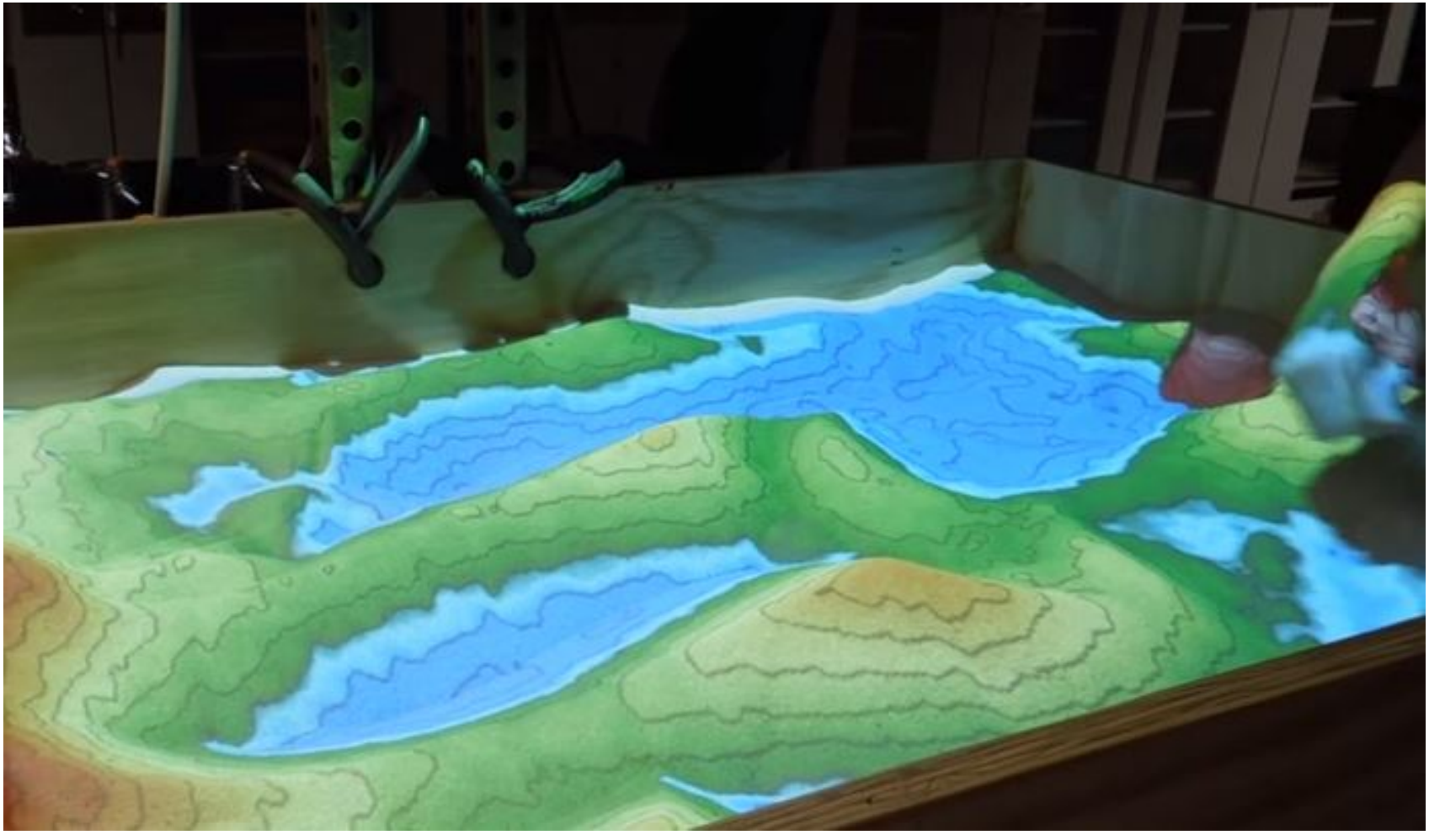
Virtual Reality

- Completely Virtual
- The Matrix
- Oculus Rift

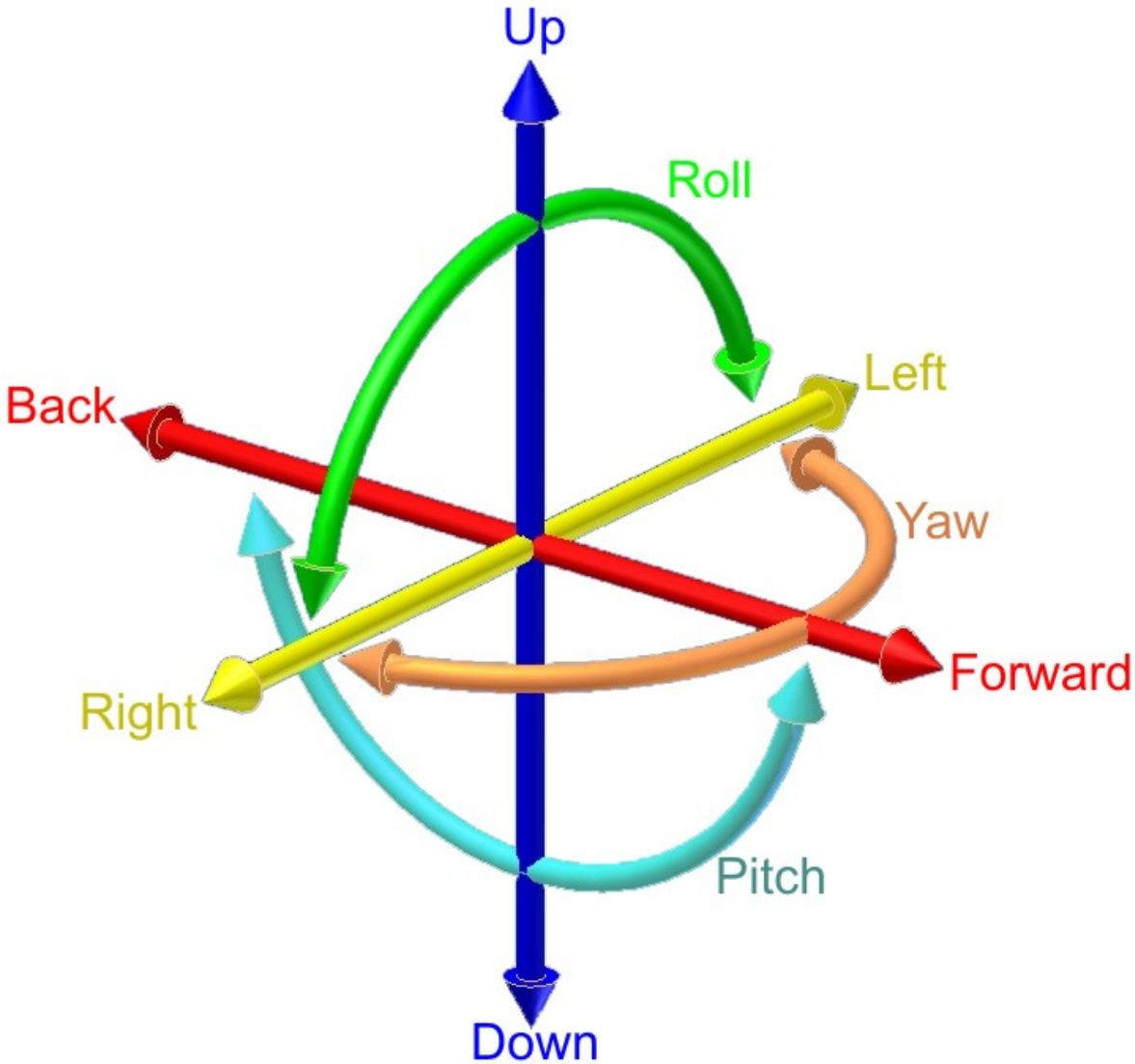
Augmented Reality



Spatial Augmented Reality

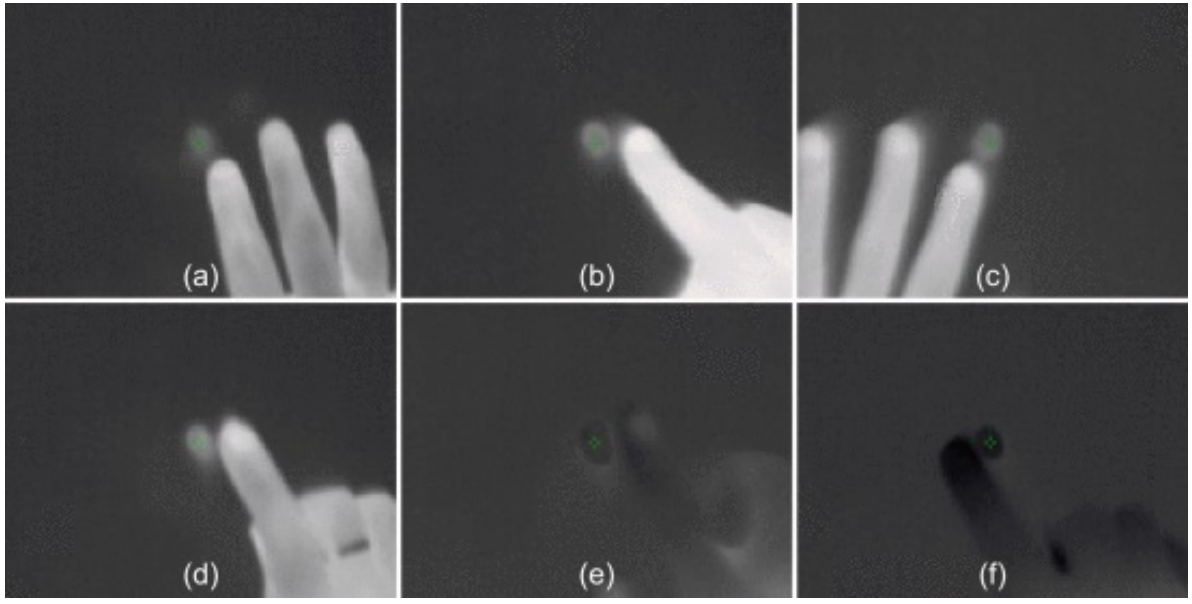


6DOF



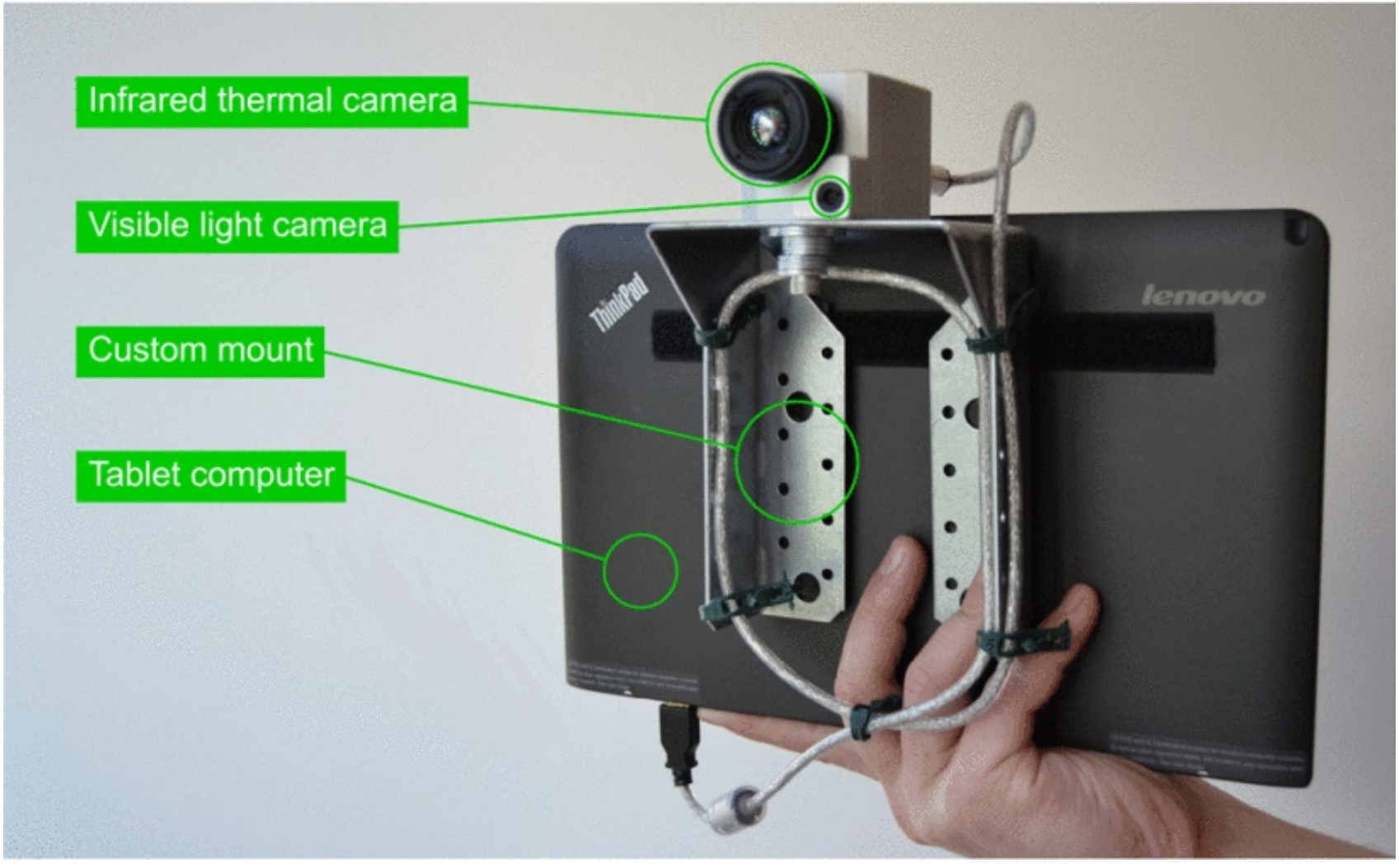
Outline

Interactions with Objects



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

Hardware


Infrared thermal camera
Visible light camera
Custom mount
Tablet computer
ThinkPad
lenovo

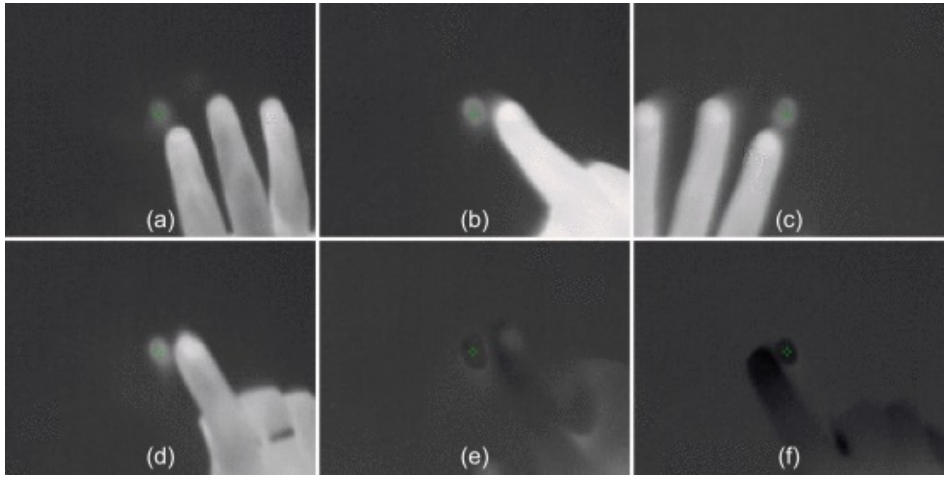
Thermal Detection

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

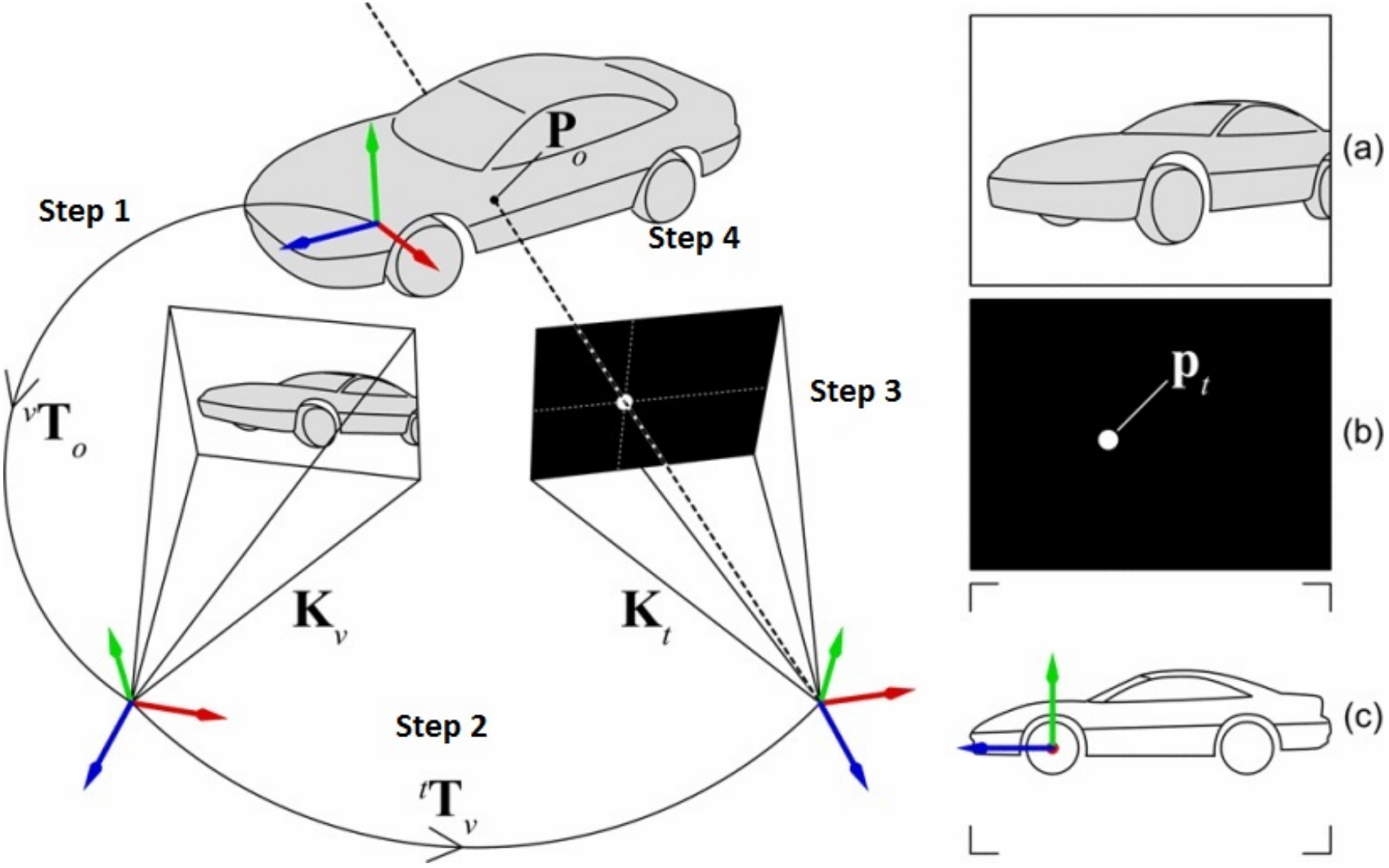
OpenCV SimpleBlobDetector

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

- 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



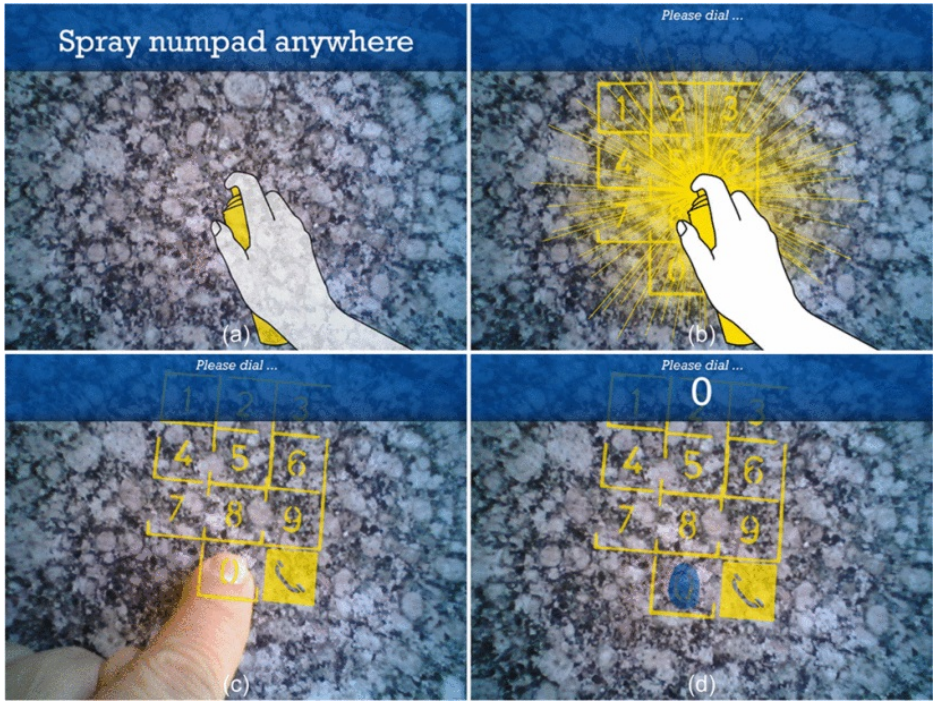
Applications

Applications that use thermal imaging with mobile technology

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

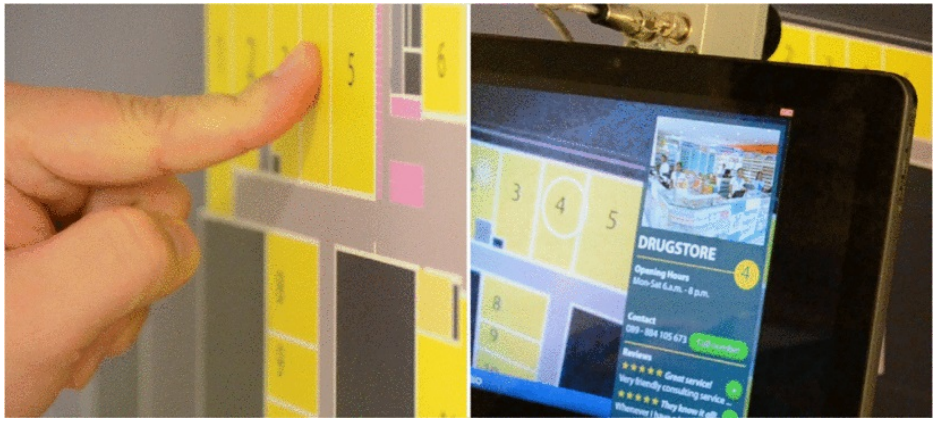
"Spray on" GUIs

- 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 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

- 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

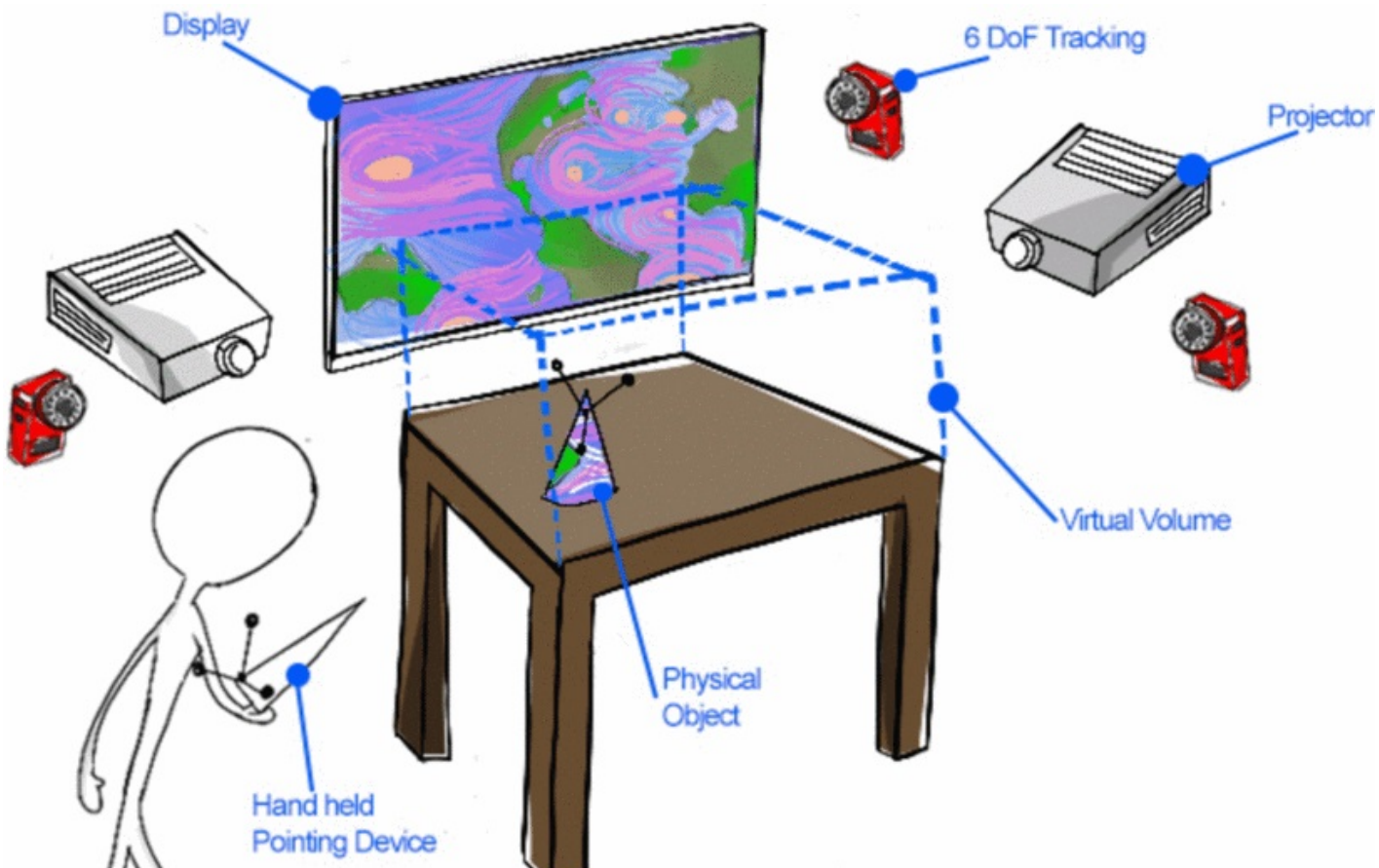
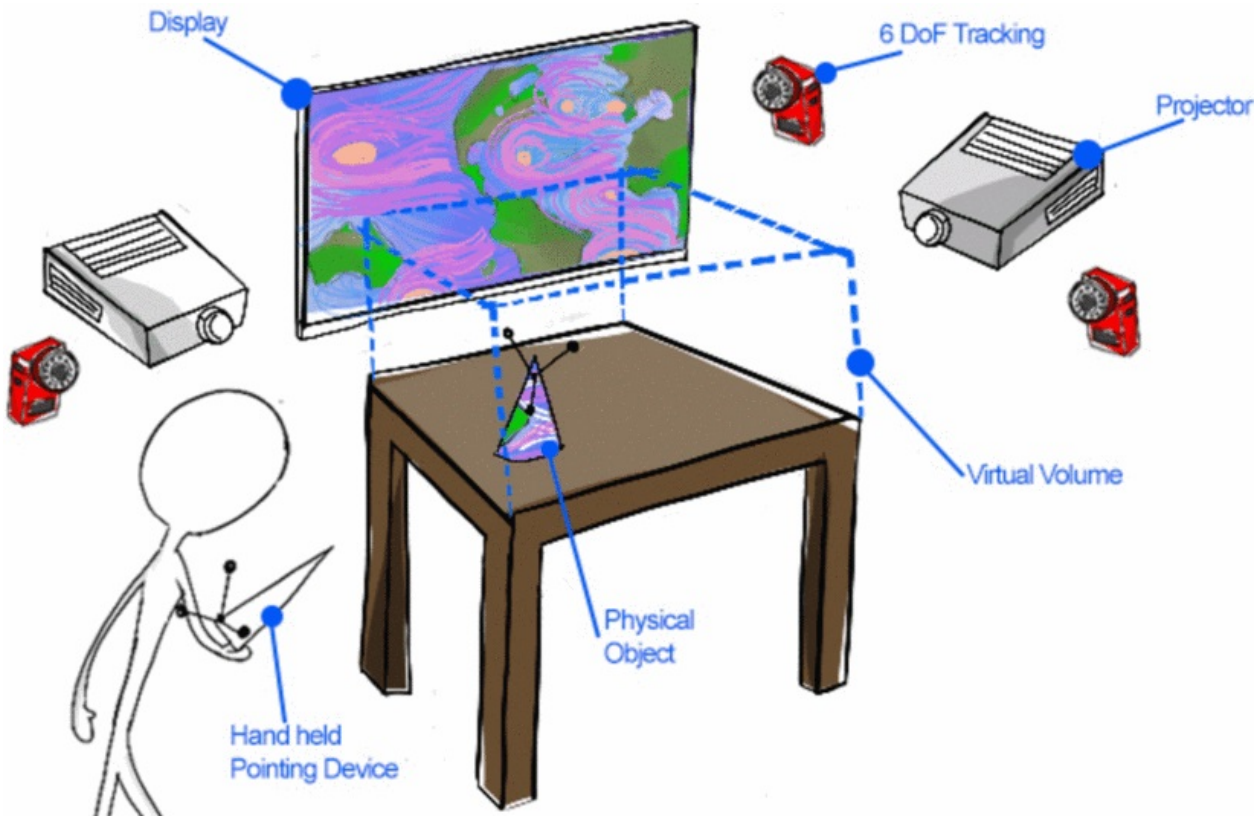


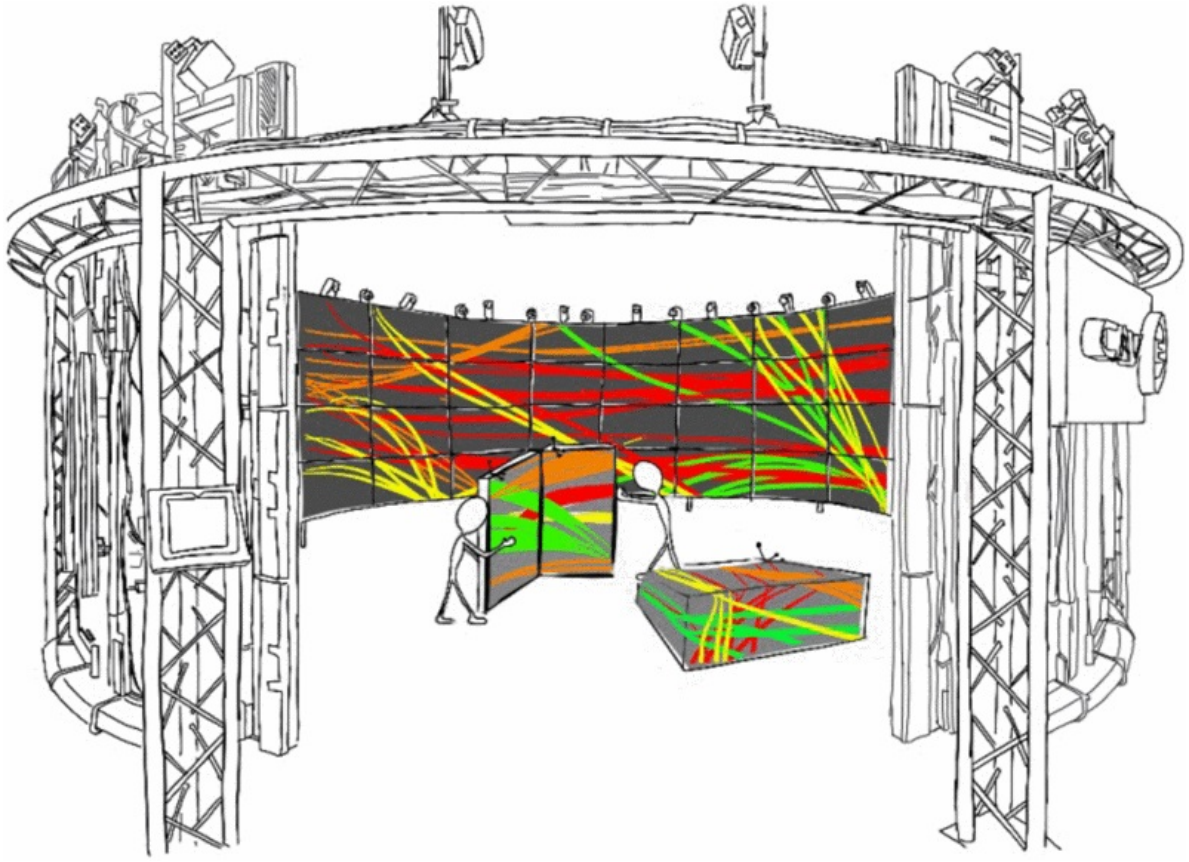
Table-Top

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



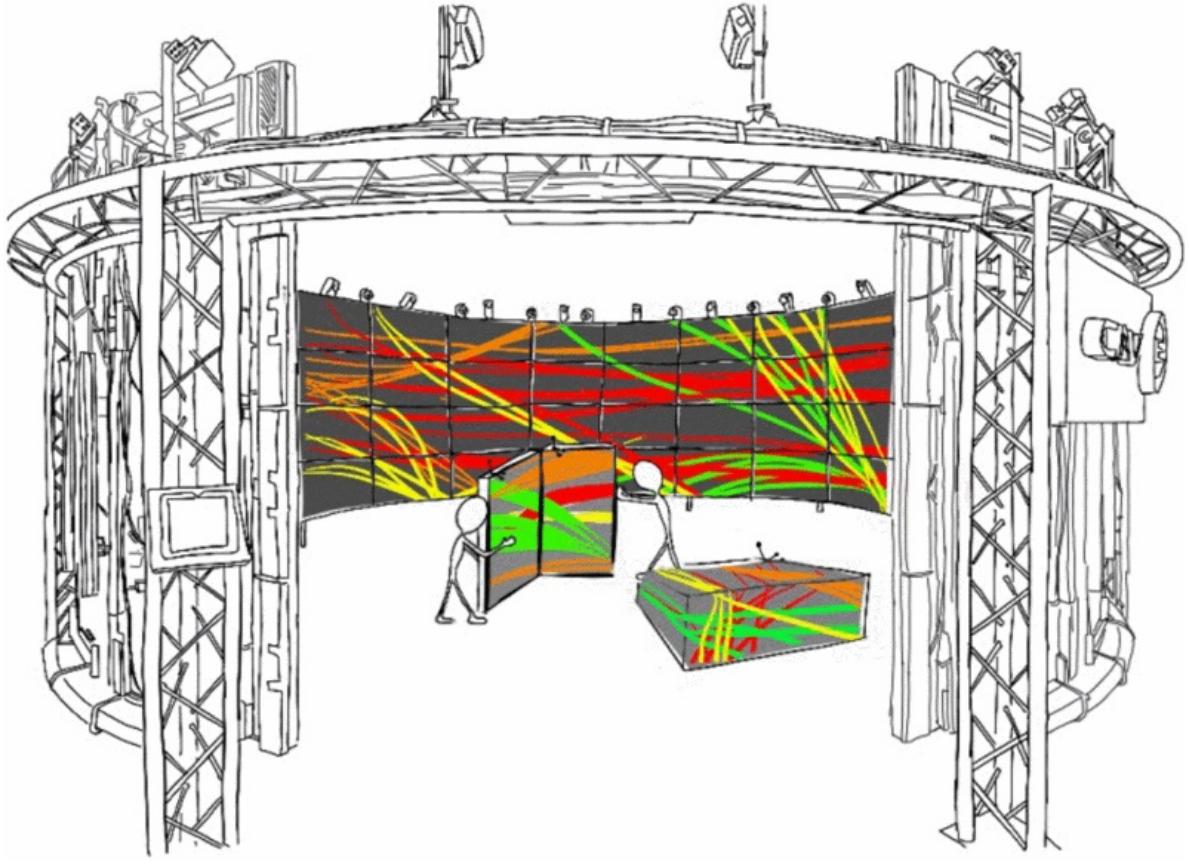
CAVE

- 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
- 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

Thanks!

Thank you for your time and attention!

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Any Questions?