LMU LUDWIG-MAXIMILIANS-UNIVERSITÄT MÜNCHEN

Media Informatics Group ▪ Florian Schulz

Design and Implementation of a Curved Multi-Touch Desktop

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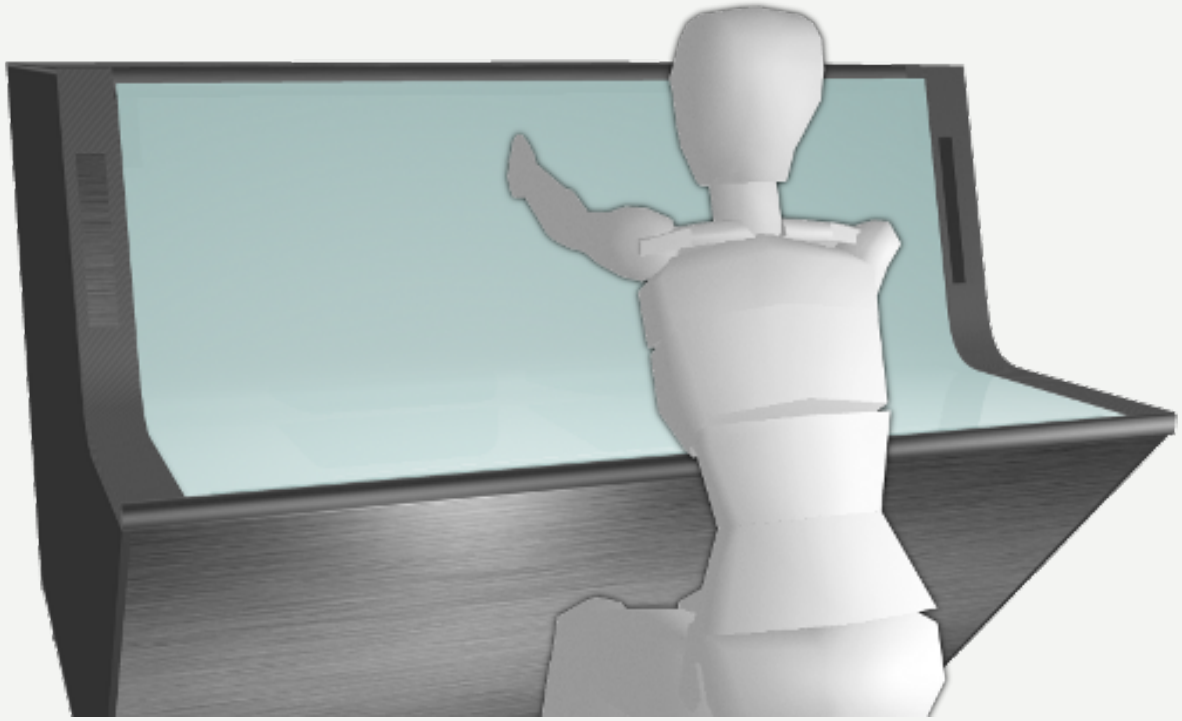
CURVE - Outline

- Motivation
- Overview
- Related Work
- Design Process
- User Study
- Implementation
- Outlook

CURVE - Motivation

- used to work on vertical screens
- some tasks better done on horizontal surfaces
- connection of both might enhance the users' work-flow

CURVE - Motivation

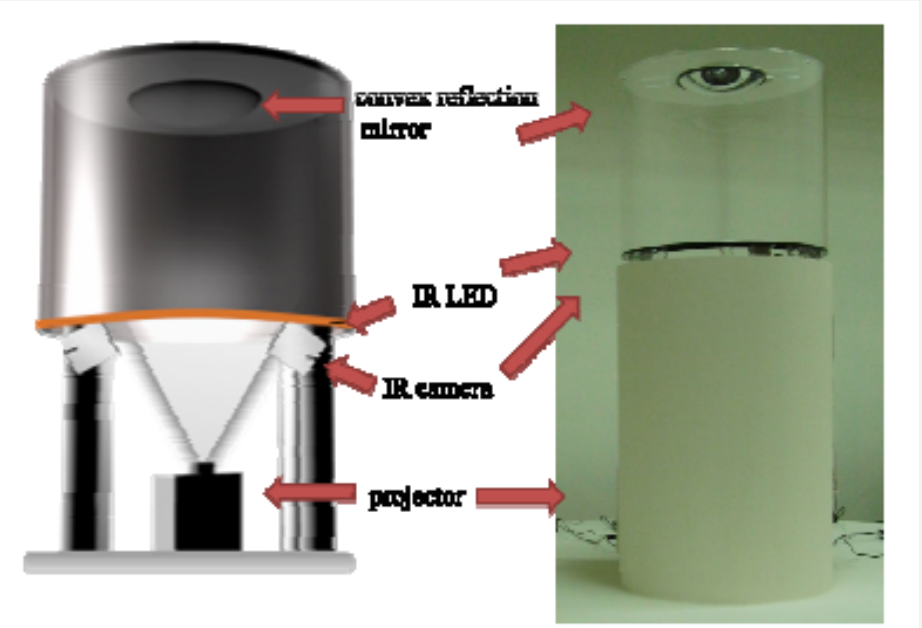


curve

- curved interactive display with multi-modal input
- combining horizontal and vertical interactive surfaces
- application area: everyday (office) work

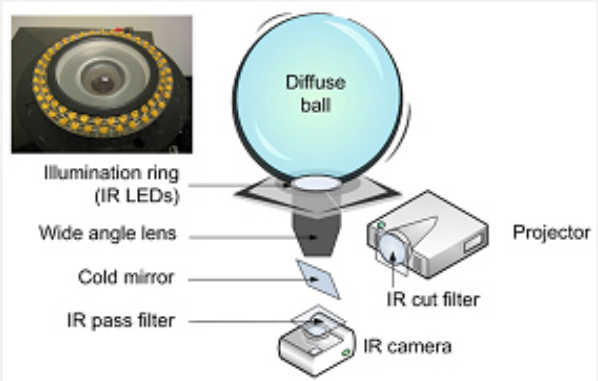
CURVE - Related Work

i-m-Tube



Lin et al., 2009

Benko et al., 2008



Sphere

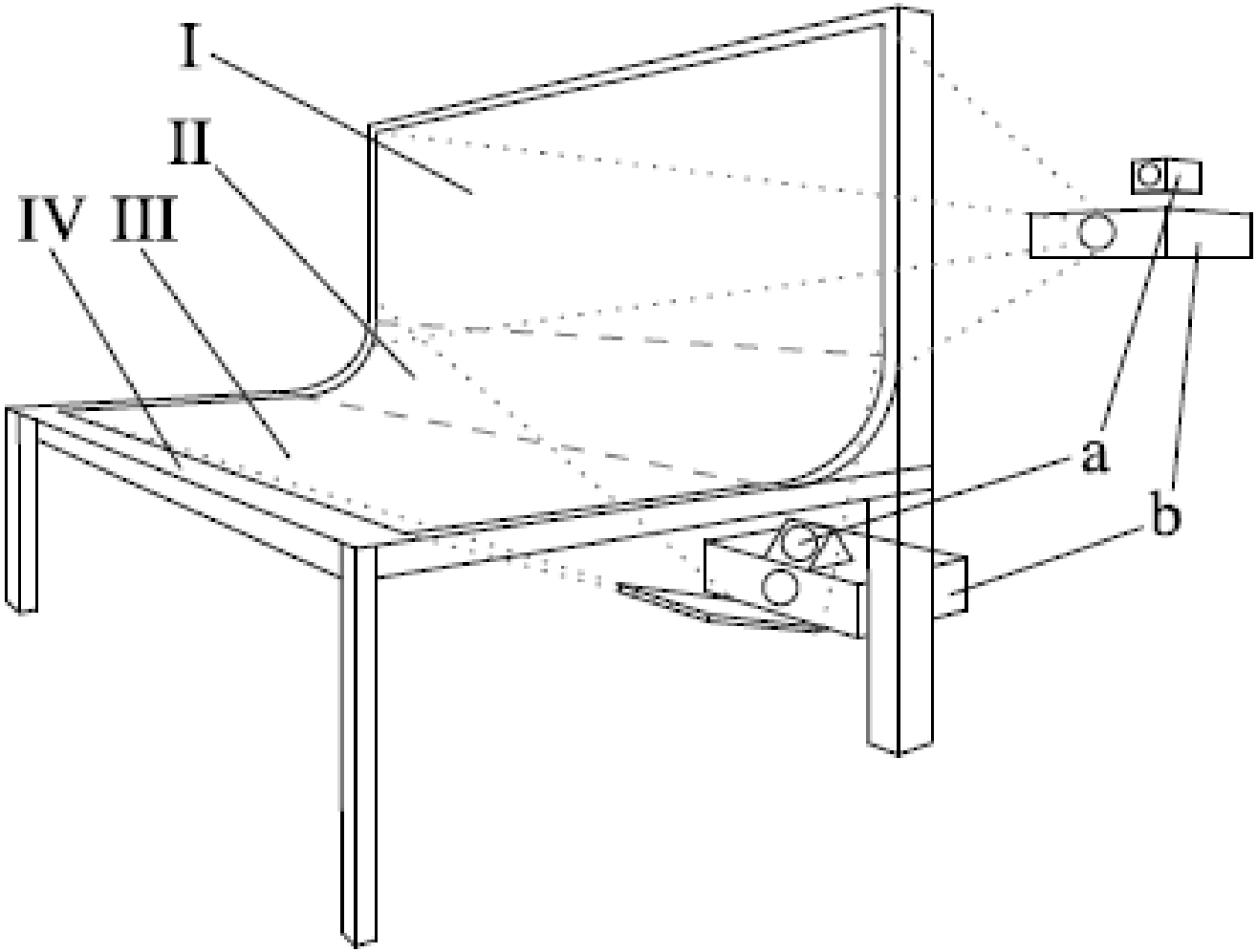
CURVE - Related Work

Starfire Interaction Video

http://www.asktog.com/starfire/index.html

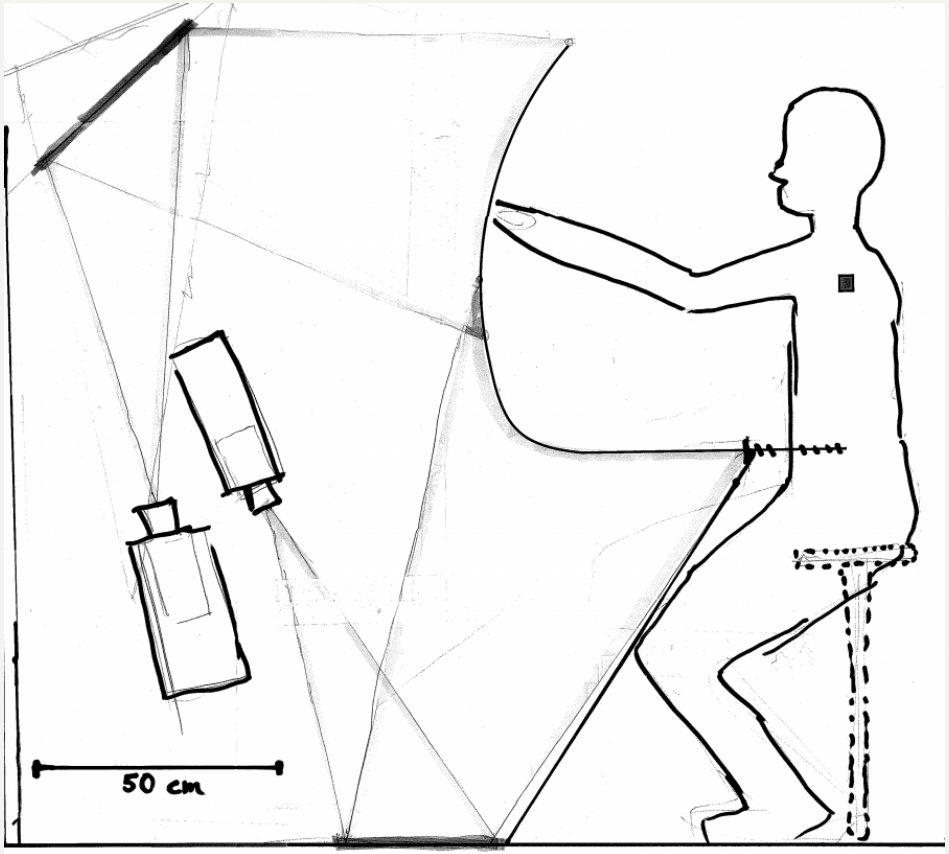
CURVE - Related Work

Weiss et al., 2009



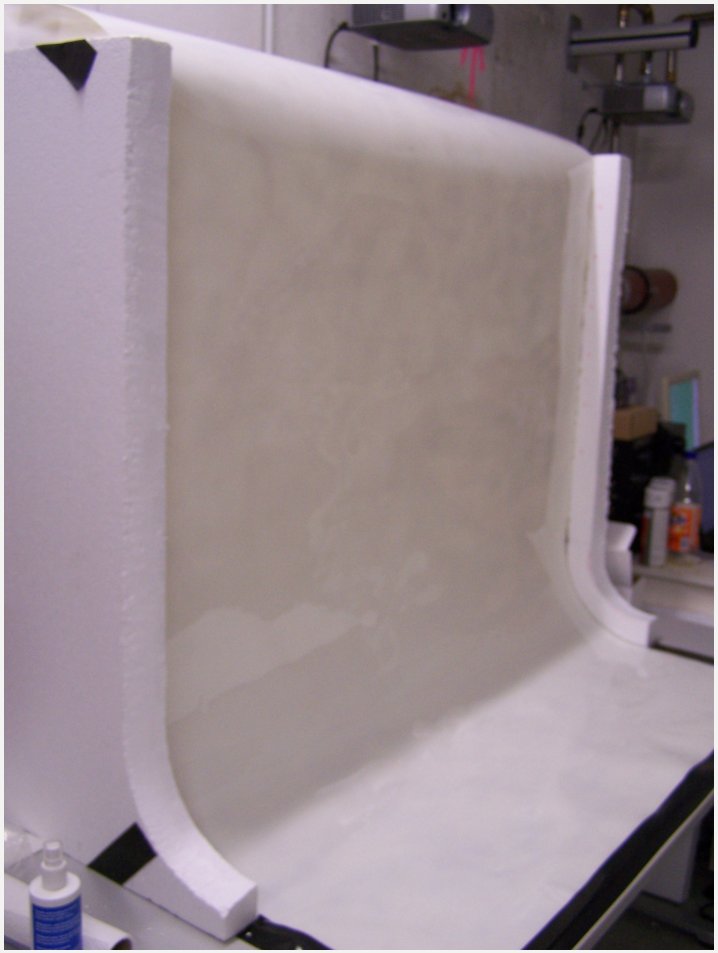
BendDesk

CURVE - Design Process



First Drawing

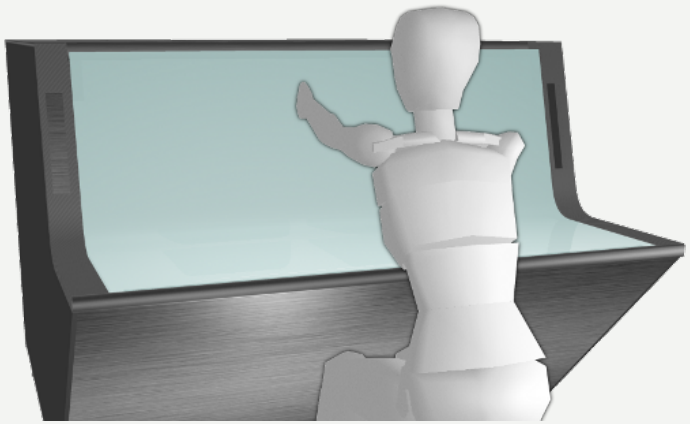
CURVE - Design Process



→ Expert Discussion:

- too high
- no inclination
- general challenge of vertical (touch) display

CURVE - Design Process



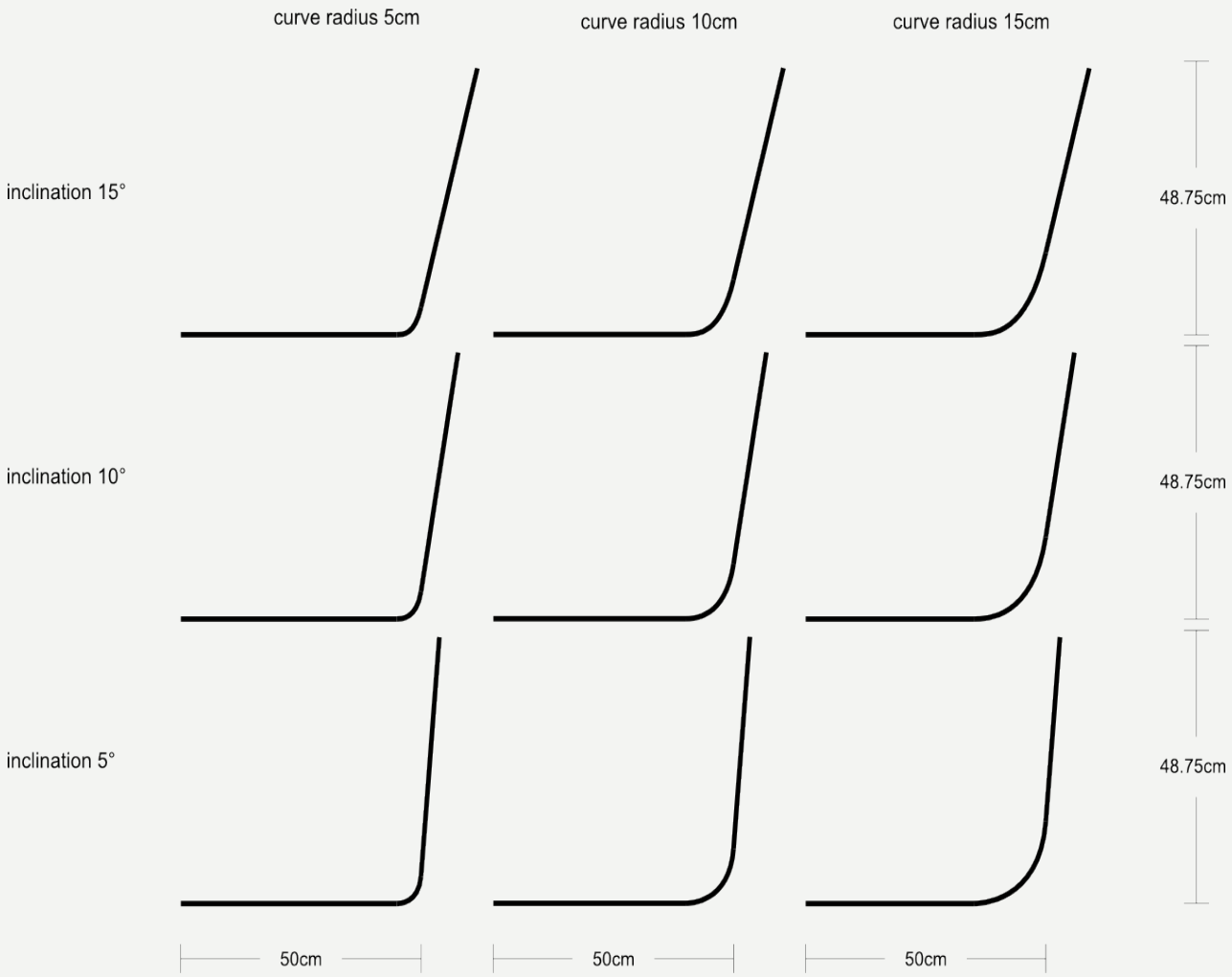
Integration of Ergonomics Standards

- width of 120 cm
- depth of 45 to 50 cm
- table height of 72 cm

→ Open Attributes:

- actual display height
- curve radius
- backward inclination of vertical display part

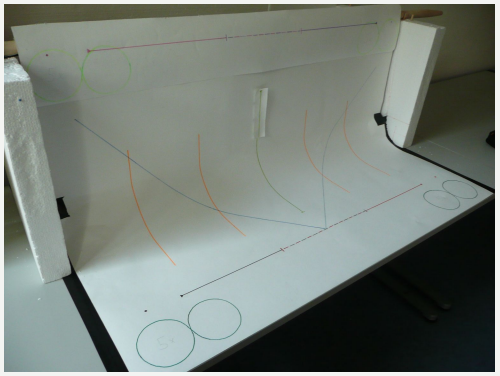
CURVE - Design Process



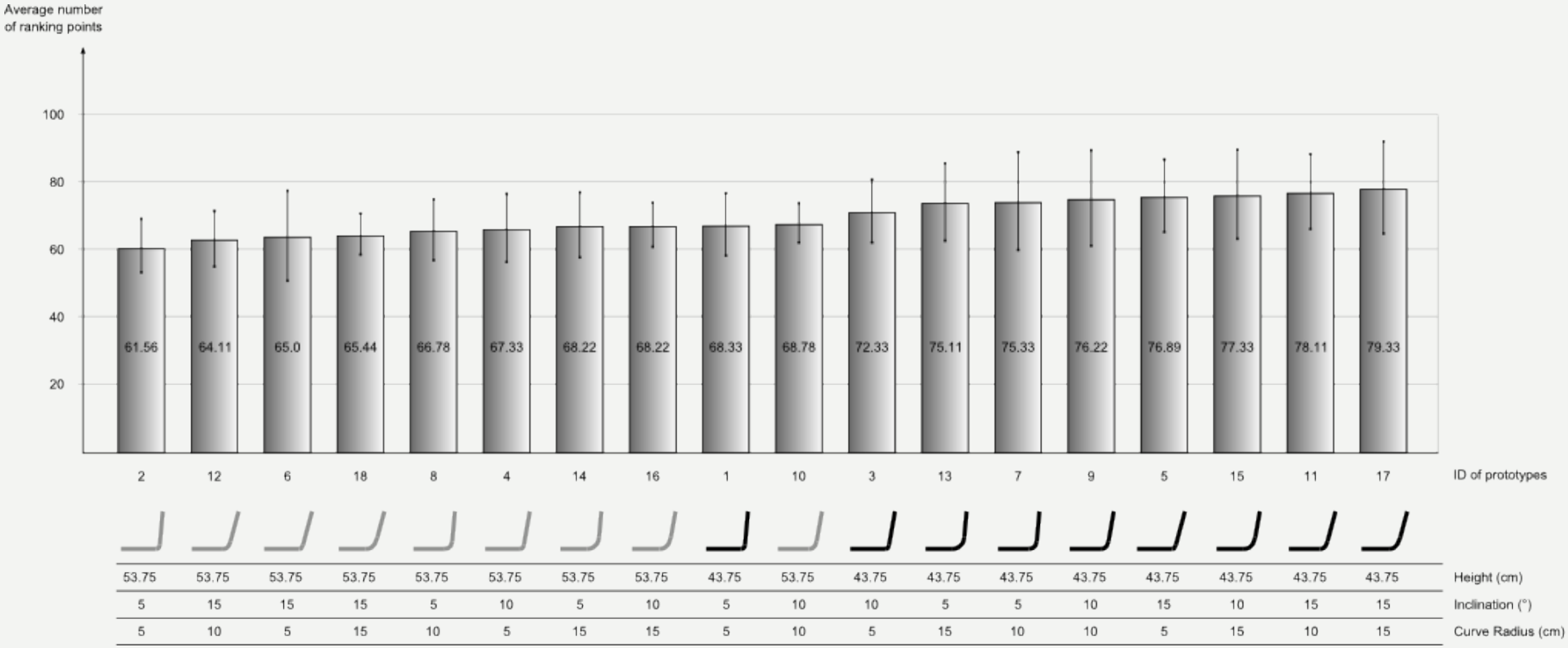
CURVE - User Study

Experimentation:

- mainly qualitative user study
- nine participants
- participants have to draw different paths on the paper screens
- short questionnaires after each task

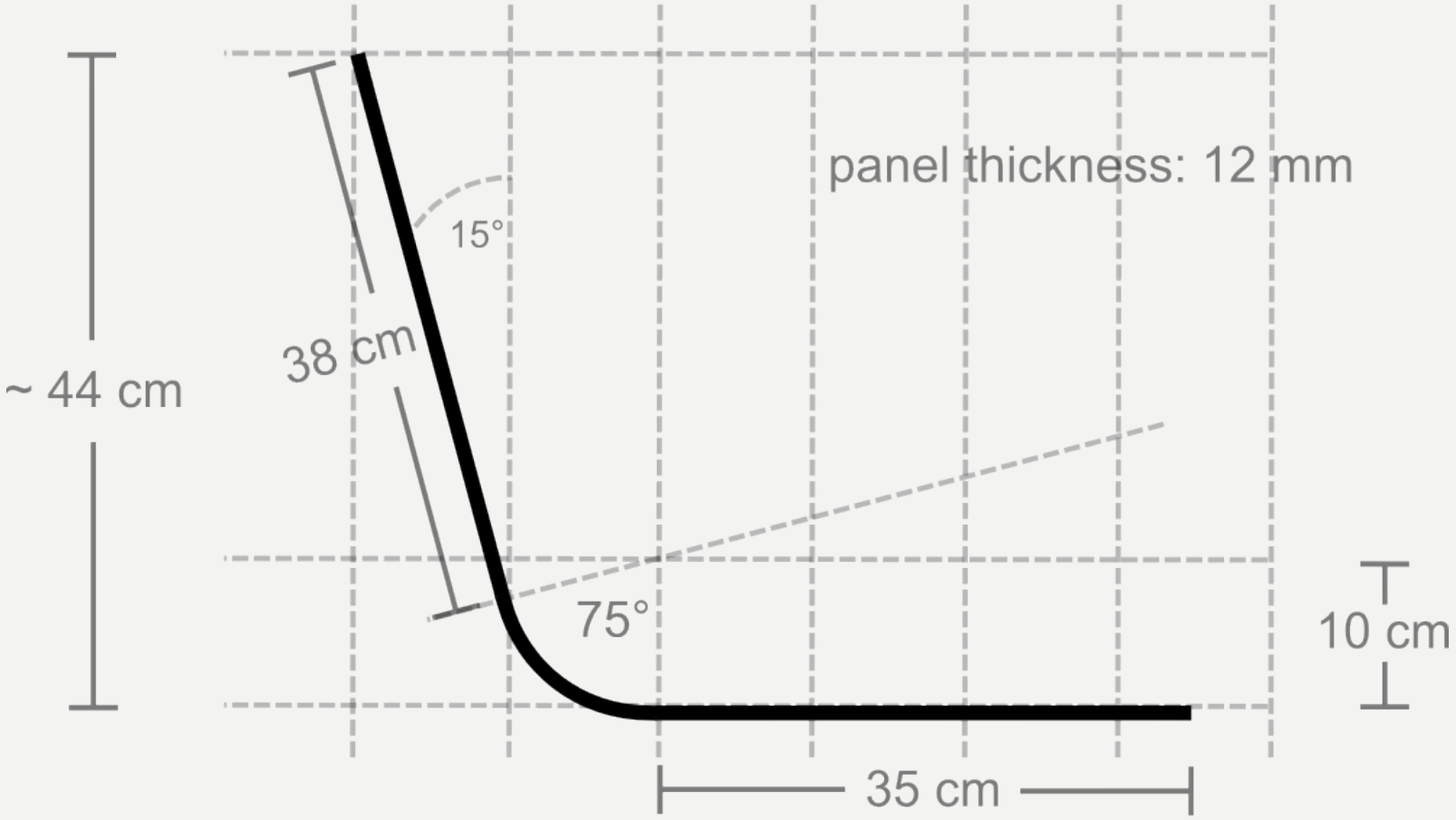


CURVE - User Study

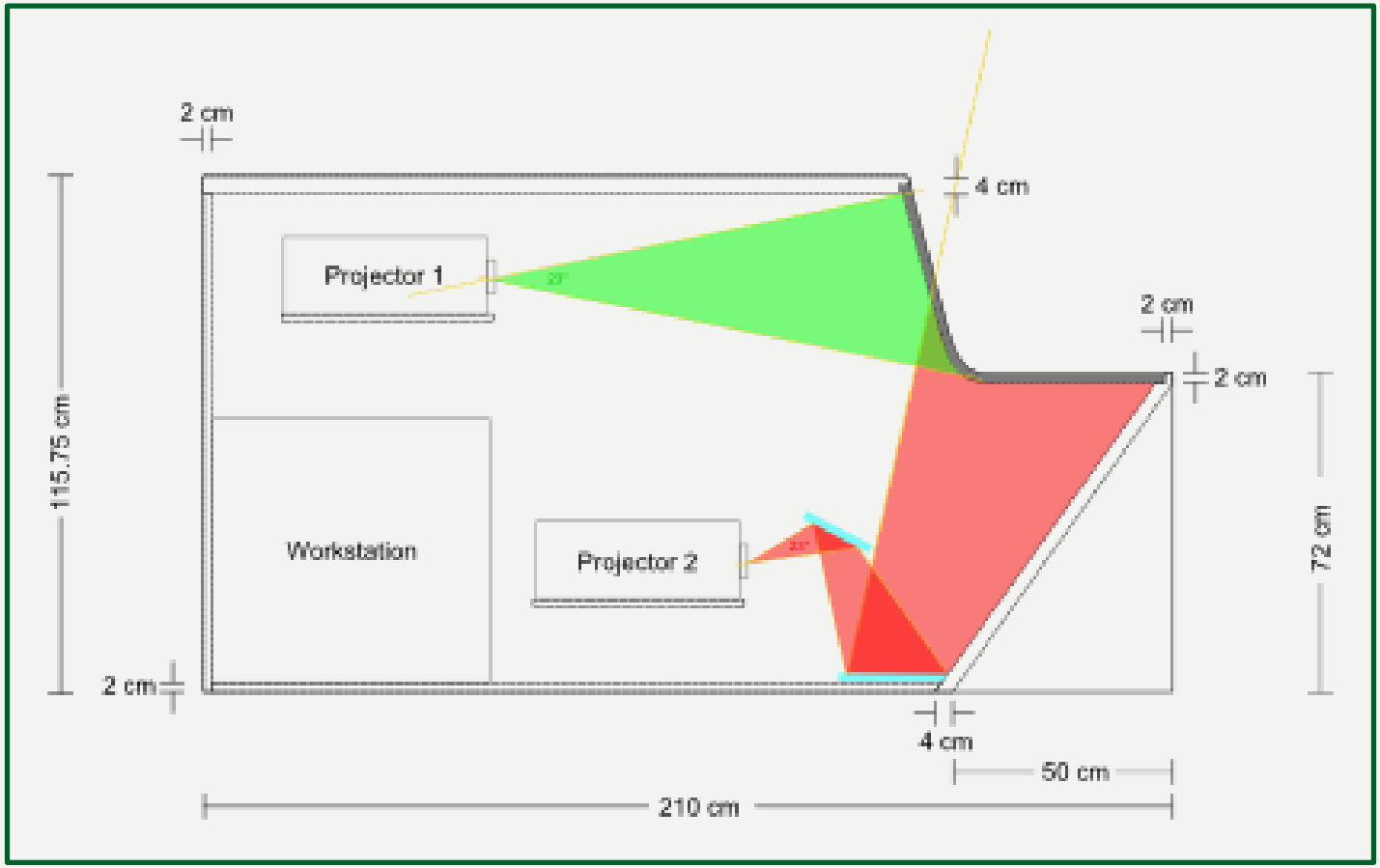


ID of prototypes	2	12	6	18	8	4	14	16	1	10	3	13	7	9	5	15	11	17
Height (cm)	53.75	53.75	53.75	53.75	53.75	53.75	53.75	53.75	43.75	53.75	43.75	43.75	43.75	43.75	43.75	43.75	43.75	43.75
Inclination (°)	5	15	15	15	5	10	5	10	5	10	10	5	5	10	15	10	15	15
Curve Radius (cm)	5	10	5	15	10	5	15	15	5	10	5	15	10	10	5	15	10	15

→ Final panel dimensions:

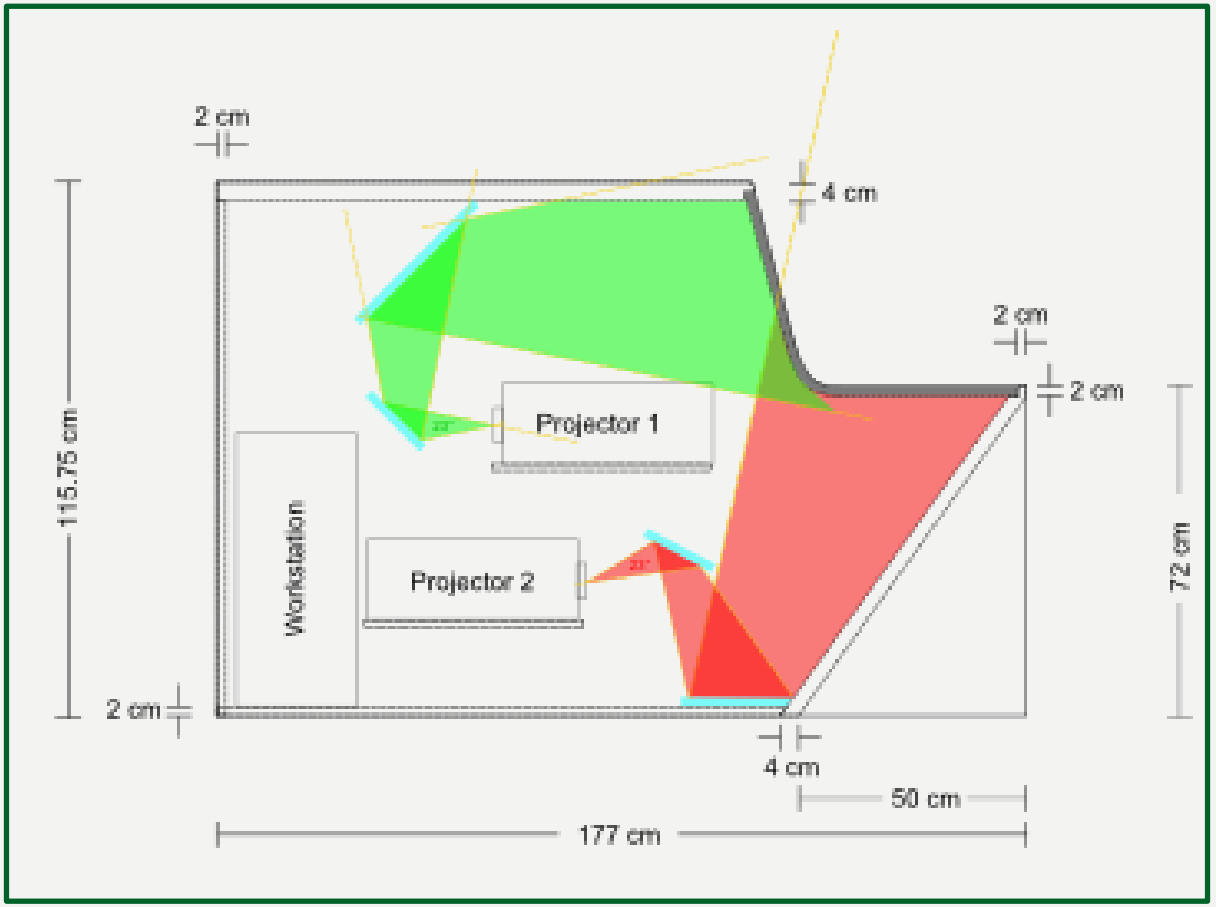


CURVE - Final Design Process



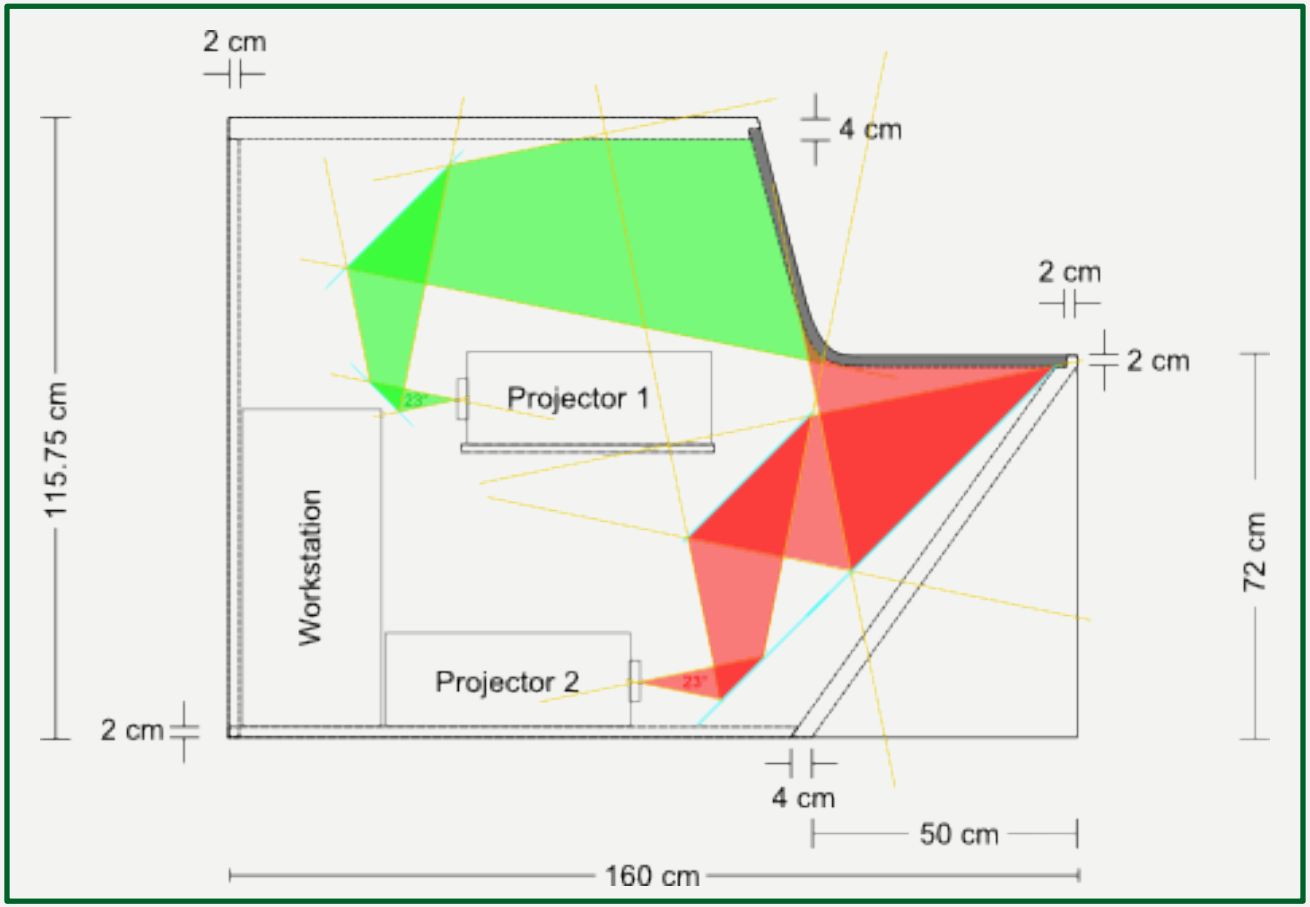
setup with two mirrors

CURVE - Final Design Process



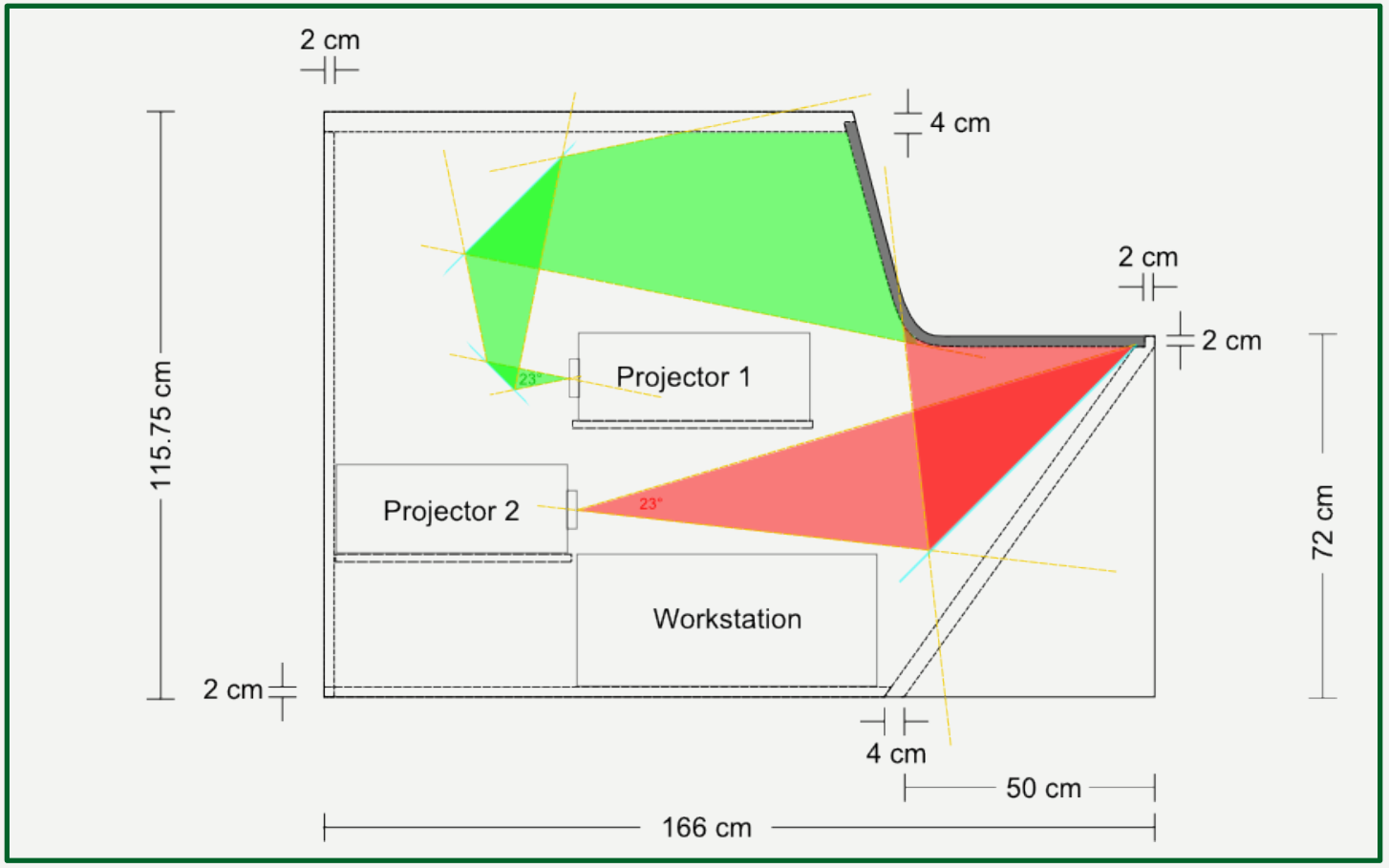
setup with 4 mirrors

CURVE - Final Design Process



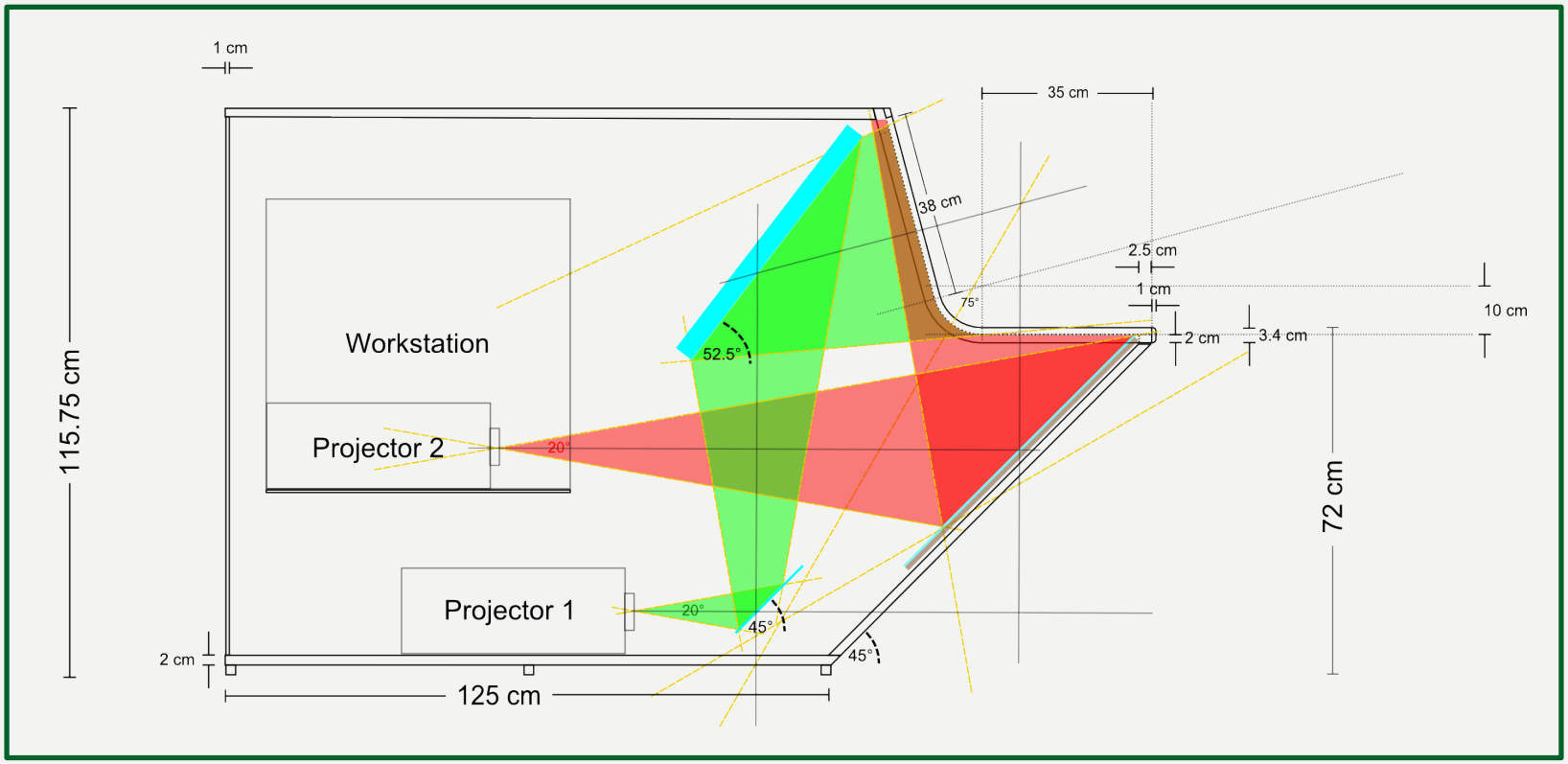
setup with 4-5 mirrors

CURVE - Final Design Process



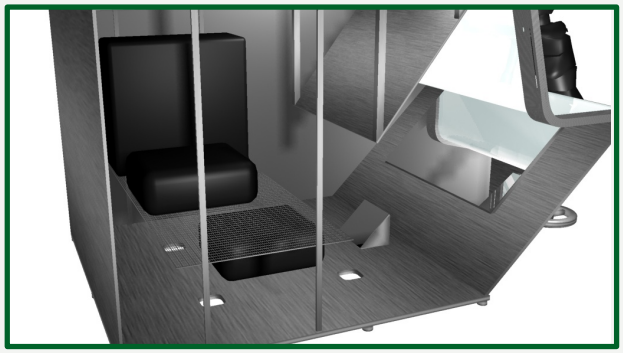
setup with 3 mirrors

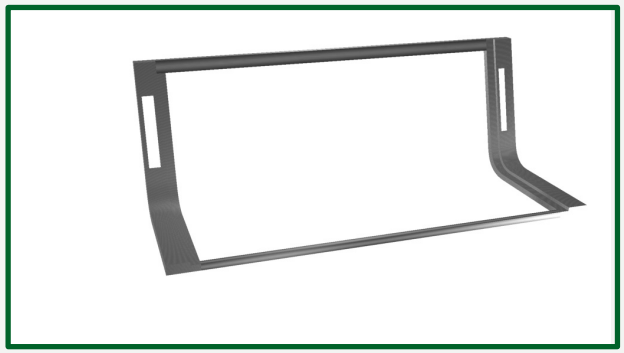
CURVE - Final Design Process



final
mirror setup

CURVE - Implementation



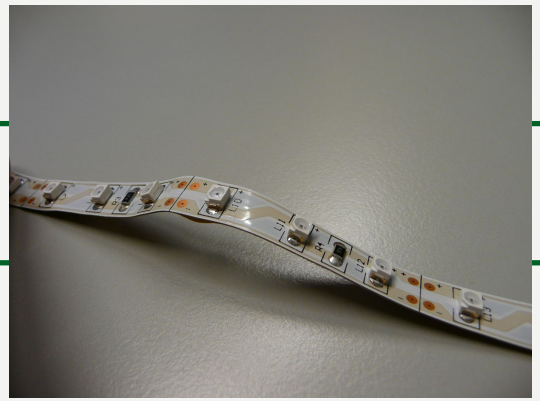


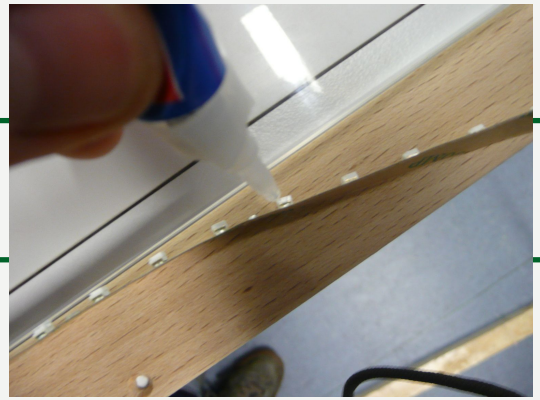
construction of the casing by the carpentry of the LMU

CURVE - Implementation

Input:

- multi-modal in the long term
- as a start: keyboard, mouse, multi-touch using FTIR
- four *Point Grey Firefly MV* cameras (640 x 480 px at 63 fps)
- IR LED strips glued to the edges of the acrylic





CURVE - Implementation

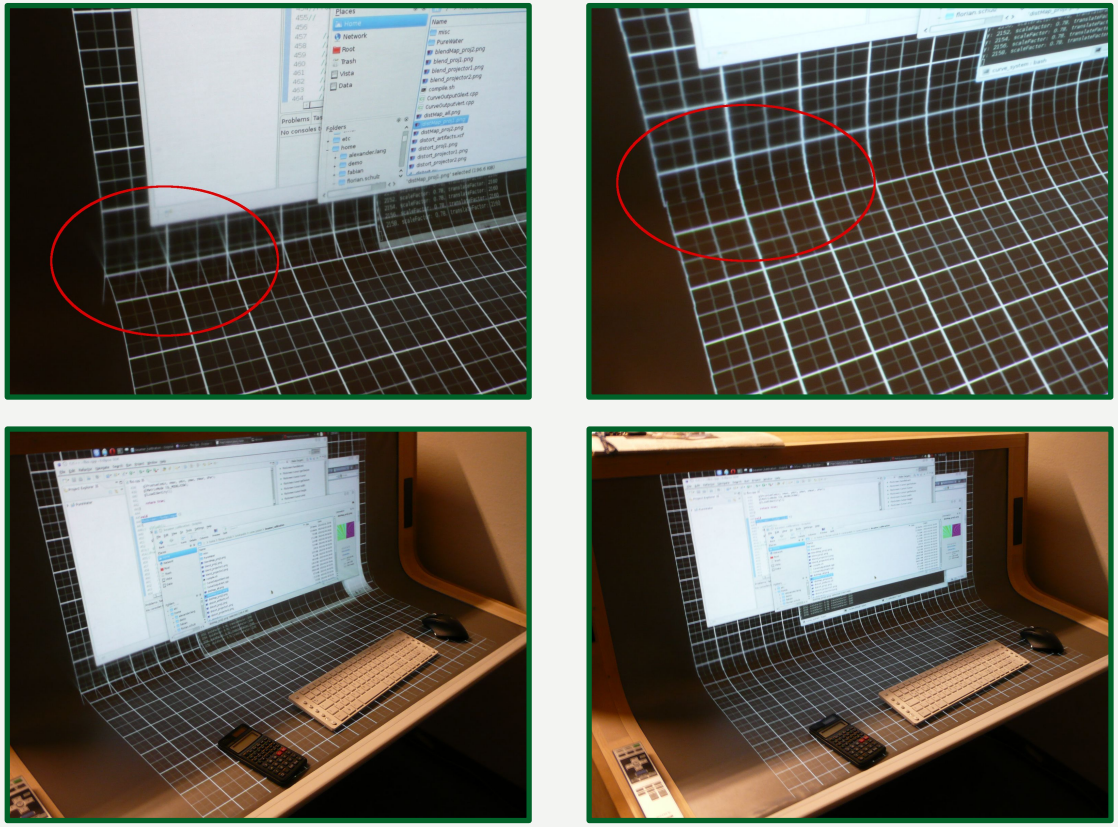
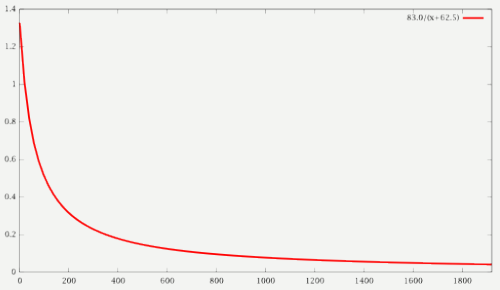


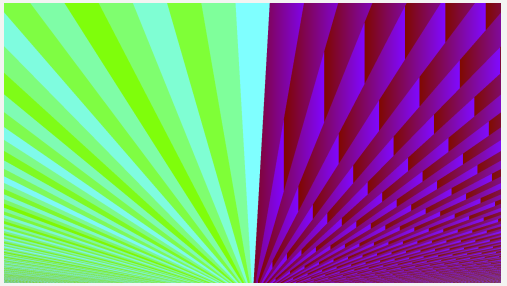
image correction results

CURVE - Implementation

Output:

- images need to be pre-warped and scaled to get an undistorted view in the curve
- as a start: manual output calibration using distortion maps
- map creation with a small *Java* tool
- actual image processing using shaders with a *Compiz*[1] plugin (fallback solution: distortion of a textured grid on CPU)





1. Compiz is a 3D compositing window manager; for further information, see http://www.compiz.org/

CURVE - Outlook

- development of *Curve* still in progress
- output calibration should be refined
- direct-touch input does not work yet

Thank you

References

H. Benko, et al. (2008). `Sphere: multi-touch interactions on a spherical display'. In UIST '08: Proceedings of the 21st annual ACM symposium on User interface software and technology, pp. 77-86, New York, NY, USA. ACM.

J. Y. Han (2005). `Low-cost multi-touch sensing through frustrated total internal reflection'. In UIST '05: Proceedings of the 18th annual ACM symposium on User interface software and technology, pp. 115-118, New York, NY, USA. ACM Press.

W. Lange and A. Windel. Kleine Ergonomische Datensammlung. TÜV Media, 2008.

J. Y. Lin, Y. Y. Chen, J. C. Ko, H. Kao, W. H. Chen, T. H. Tsai, S. C. Hsu, and Y. P. Hung. i-m-tube: an interactive multi-resolution tubular display. In MM '09: Proceedings of the seventeen ACM international conference on Multimedia, pages 253–260, New York, NY, USA, 2009. ACM.

http://mtg.upf.edu/reactable/

http://www.microsoft.com/surface/Pages/Product/WhatIs.aspx

http://nuigroup.com/forums/viewthread/1982/

M. Weiss, S. Voelker, and J. Borchers. BendDesk: Seamless Integration of Horizontal and Vertical Multi-Touch Surfaces in Desk Environments, 2009.