# Deskotheque Display System
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### Projection Environment

The multi-projector display of the *TIYF!* installation is located in a 10x10x3 meters (WxHxD) space. Six projection canvases have been constructed. Each canvas is tilted by 10 to 20 degrees towards the room center and seamlessly connected to its neighboring canvases. The result-ing projection surface has a perimeter of almost 20 meters and fea-tures a roughly circular shape around the room centre thereby spreading an angle of approx. 270 degrees. The entire surface is lit by eight overlapping projectors. For the de-tection of the projected geometry, eight cameras are required. Projectors and cameras are all connected with a single PC.
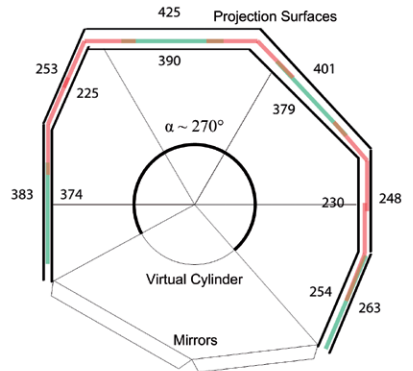
### Surface-Adaptive Projection Displays

Media art installations are usually located in indoor rooms. These spaces per se provide a large set of possible projection surfaces: walls, floor and ceiling. Naturally, additional surfaces can be created by design as it was done for the TIYF installation. In order to provide a seamless projection display in such configurations, the challenge is: how to create perspectively correct and continuous images when multiple pro-jections are pointed at irregular (e.g. non-planar) surfaces.



Diagrams of
*TIYF!* projection setup
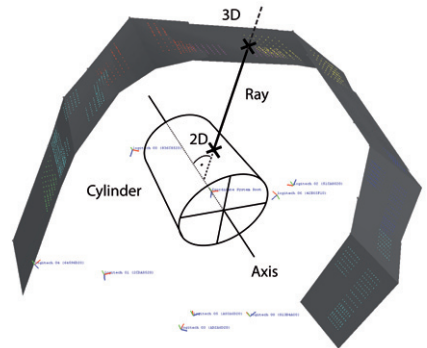
The Deskotheque[1] display system supports the deployment of multi-projector displays on multi-planar surfaces suited for configurations such as described above. We have devel-oped a projector-camera system which enables the usage of consumer hardware for the construction of continuous displays. The parallel usage of cameras allows for observing and detecting distorted projection images. These vision-based calculations finally result in a virtual three-dimensional model of the projection display environment.

### 3D Display Model: Spatial Rendering and Interaction
This 3D display model is of value for several purposes.
Firstly, it is used for compensating projective distortions and illumination effects of overlapping projections. Our system manages the rendering of graphics content on multi-projector output displays. For that purpose, a vertically aligned virtual cylinder is inserted into the center of the 3D scene. The unreeled cylinder represents the 2D input image. The actual mapping takes place by parallel projection: from the center axis of the cylinder parallel rays run out which hit the cylinder surface (2D point) as well as the display geometry (3D point). For the compensation of color gradients in the overlapping projection areas, alpha masks are computed for each projector.

Secondly, the 3D model also serves as a base for the computation of spatial inter-actions between multiple users and the input and output periphery. By registering various coordinate systems (e.g. exter-nal tracking systems, spatial audio systems) within the 3D room model, the system enables artists and programmers to handle user actions with respect to their current position and orientation within the environment. In the TIYF installation, the users' lines of sight are intersected with the dis-play geometry. The resulting 2D coordinates are used to place graphics content in the scene which is finally rendered in front of the users "eyes" on the projected display.

### Software Framework
The Deskotheque framework is essentially composed of two software components. The first component is an interactive GUI application for the camera-based calibra-tion of multi-projector displays. The outcome of the offline calibration is stored in XML format for later retrieval. The second component is the runtime library which is initialized with an existing XML dataset and provides a programming interface for the OpenGL Pd/GEM[2] applications of the TIYF installation.

### Acknowledgements and further reading
Deskotheque is an active research project executed at the **TU Graz Institute for Computer Graphics and Vision (ICG)**. We would like to thank our partners Imagination GmbH and VRVis GmbH. For further information please refer to our project homepage at http://studierstube.icg.tu-graz.ac.at/deskotheque/.

Notes:
1 http://studierstube.icg.tu-graz.ac.at/deskotheque
2 http://gem.iem.at/