

Foldable3D: Interacting with 3D Content Using Dual-Display Devices

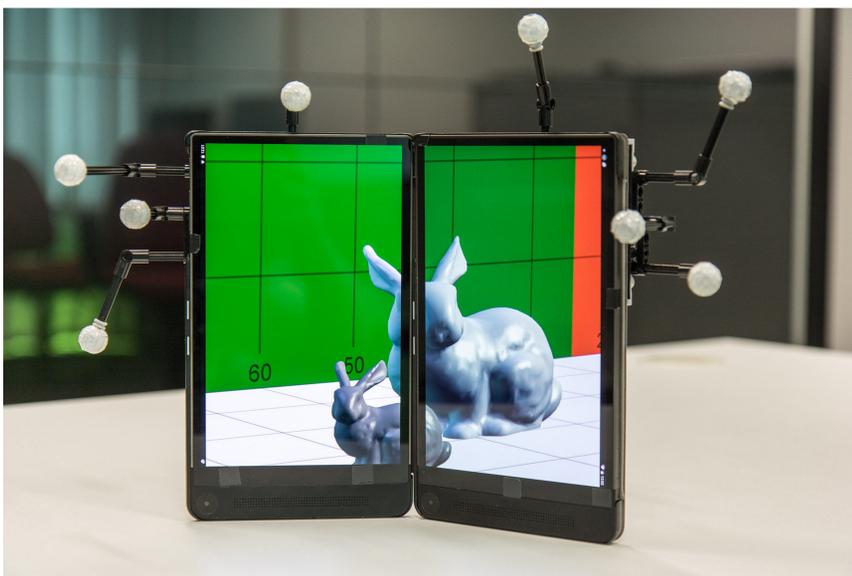
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Introduction

In this work we present the concept of mobile dual-display devices which can be folded for the exploration of 3D content. We examine different display modes and introduce new presentation and 3D interaction techniques that make use of the special form factor and the added input modality of folding two displays. In particular, we also consider the advantages of our proposed device for head-coupled perspective rendering – virtually extending the view and providing independent perspectives for two users.

The Concept of Foldable3D



Our Concept: Two displays, flexibly connected with a hinge on the long side, similar to a book (see above). The pictures show our current prototype implementation which uses an optical tracking system and provides head-coupled perspective to the user (see below).



Input Modalities:

- Each display supports multi-touch input.
- Folding angle can be measured as additional input modality
- Face-tracking to support head-coupled perspective (HCP)

Example use cases for our proposed device are:

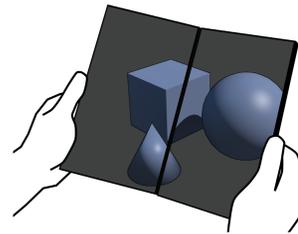
- The inspection of 3D content in a mobile setting
- Augmented Reality applications, e.g., for interior design and decoration.
- 3D games & entertainment

Advantages of Foldable3D for those use cases:

1. The combination of two angled screens provides a larger viewing angle, allowing for a more flexible use of HCP.
2. Folding serves as an additional degree of freedom for interaction, providing another input modality.
3. Two individual but connected screens support both the meaningful arrangement of content and new interaction techniques.

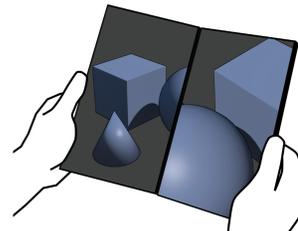
Screen Usage & Mode Changes

According to the relationship between the content of the two screens, we propose to differentiate between three classes of content relations for 3D interaction:



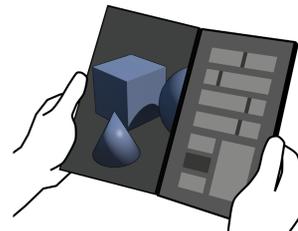
Unified Workspaces:

- Displays form one large, unified viewport
- Enables larger viewing angle for HCP
- Provides two spatially configurable input surfaces



Connected Workspaces:

- Two separate viewports into the same scene
- E.g., two perspectives at the same time
- Also supports co-located multiuser tasks (see below)

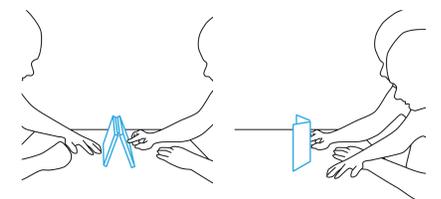


Extended Workspaces:

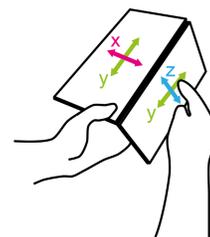
- One display is viewport into scene
- Secondary screen show independent, different functionality
- E.g., offloading of user interface palettes

Mode Changes:

- Workspaces are changed in relation to display configuration & device orientation
- E.g., switch between independent (left) and collaborative (right) multiuser configurations

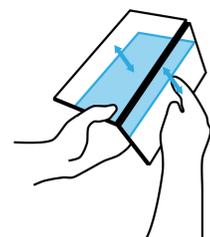


Techniques for 3D Interaction



Rotation & Translation Frame of Reference:

- Rotate & translate with touch
- Degrees of freedom mapped to device screens depending on spatial configuration
- Allows unambiguous interaction



Clipping & Snapping Planes:

- Easy support for placement/control of clipping or snapping planes
- Planes can be manipulated on one display without obstructing the view for the user

Camera Control by Folding:

- Folding angle used to control the zoom level
- To be compatible to HCP: Use dolly movement instead of changing the field of view



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