Design for Abstraction and Implementation of 3D User Interfaces with regard to Augmented and Virtual Reality Applications

Moritz Schirra, Maximilian Hess

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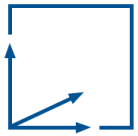


Final: Bachelor Informatik: Games Engineering

Supervisors: Prof. Gudrun Klinker, Sven Liedtke

Introduction & Motivation

- Has become more popular in recent years
- Similarities between Augmented and Virtual Reality devices
- Make it easier for new developers to create interfaces for multiple Augmented and Virtual Reality devices
- Sven working on an engine for Augmented and Virtual Reality applications

Problem Description: Issues

Despite general similarities, specific interactions vary across various systems:

Goals of these Theses

- User interface system for Augmented and Virtual Reality environments
- Automated mapping and adjusting of user interfaces to different devices
- Includes display of and interaction with user interfaces in 3D space
- Basic concept for a user interface system
- Demonstrative implementation

Critical Research Issues

- How can these different devices be mapped to the same user interface in a similar way?
- Allow developers a more uniform workflow regardless of the used system

Existing Solutions

- Windows Mixed Reality Toolkit as a solution for multiple Augmented and Virtual Reality devices

  → Only few devices are covered (e.g. Meta 2 is not)
- OpenXR aiming to combine the support for most Augmented and Virtual Reality devices

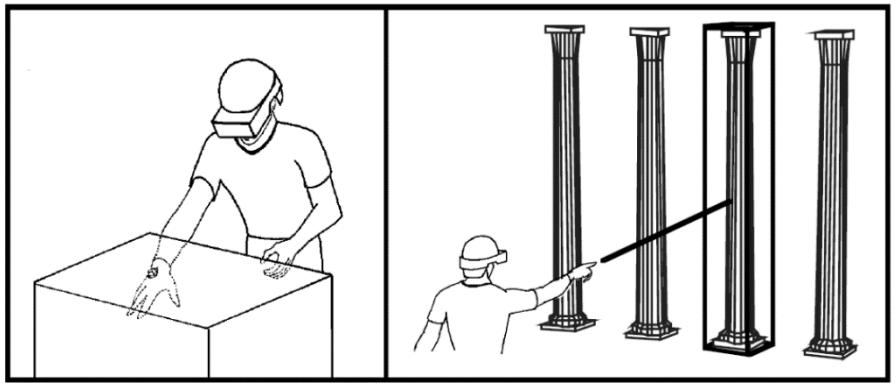
  → Still unreleased, just a demo available

Design for Abstraction and Implementation of 3D User Interfaces with regard to Virtual Reality Applications

Maximilian Hess

Related Work

- Comparison between interaction techniques in two- and three-dimensional environments
- Definitions of *local* interaction and interaction *at-a-distance* as main techniques in Virtual Reality



Related Work

- Analysis of general user interface guidelines
- Introduction of multi-target user interfaces
- Integrating two-dimensional user interfaces in 3D space
- New possiblities through the use of 3D widgets

Approach

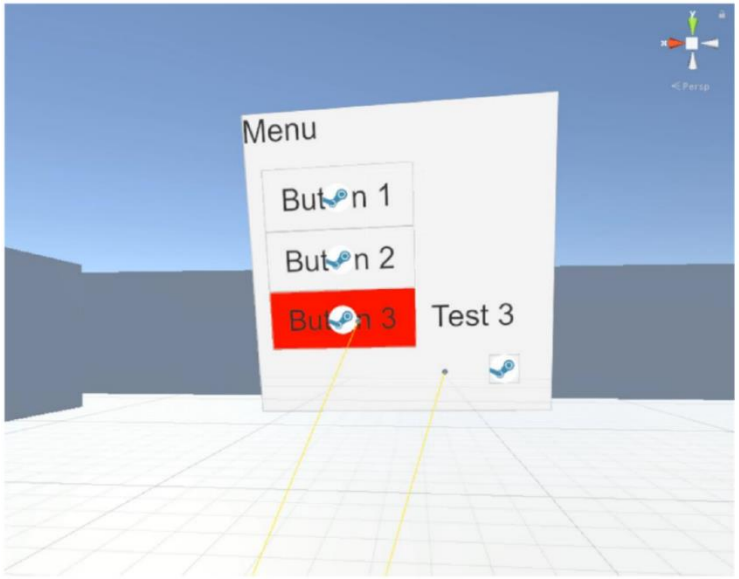
- First approach: Building on what the devices have in common
  - Both offer an HMD with similar specifications
  - A pair of motion controllers and multiple sensors distributed across the room are available for both systems
- Solution: Developing a uniform pipeline of communication between the input device and the user interface across all systems

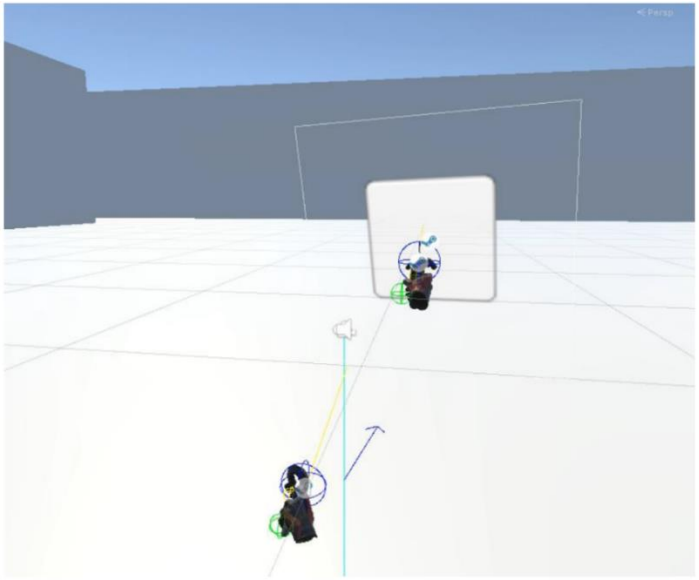
Implementation

- Implementation of an example scene in Unity3D
  - One central script setting up the scene adjusting it to the connected device
  - Handling of input and interaction is distributed across multiple scrips along a uniform pipeline
  - Use of an own button script and ray-casting mostly indepented of SDK functions

Implementation

- Implementation of an example scene in Unity3D
  - Implementation of *at-a-distance* and *gaze-directed* interaction with a user interface, e.g. a list
  - Fundamental implementation of local interaction and a foundation for 3D widgets





Suggested Future Work

- Implementation of a two-dimensional interface in a three-dimensional environment

  → Future Approach: Explore area of three-dimensional user interfaces in full depth
- Regular updates of OculusVR and SteamVR require continuous maintenance

  → Alternatively: Adjust the implementation to work independently from the SDKs
- Expand *local* interaction to provide e.g. arm-extension techniques
- Integrate *Manipulation* and *viewpoint motion control*

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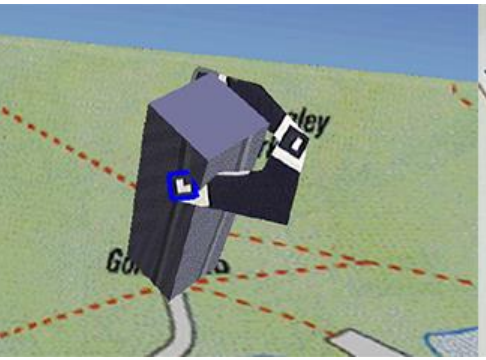
Moritz Schirra

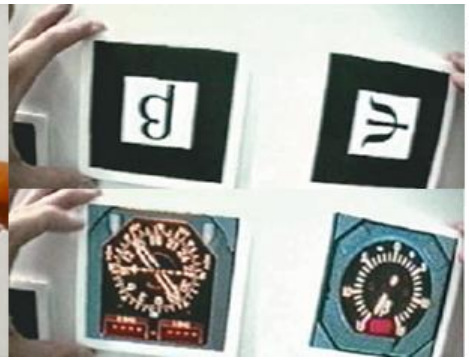
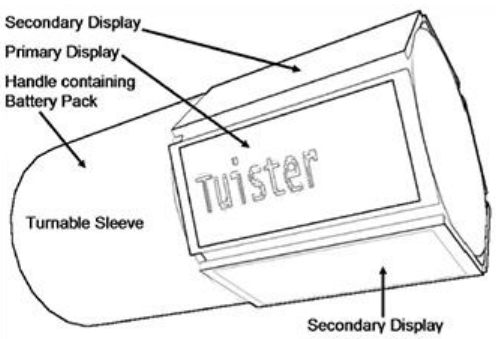
Related Work

- Comparison between interaction techniques in two- and three-dimensional environments
- Two-dimensional:
  - Windows, icons, menus and pointers (WIMP) based system
  - Input Devices (e.g. Mouse, Controller, Keyboard)
- Three-dimensional:
  - Grasping Techniques (Hand- and finger-based)
  - Pointing Techniques (Hand-, head- and eye-based)

Related Work

- Guidelines for user interfaces in two-dimensional environments
  - No guidelines for user interfaces in Augmented Reality so far
  - Application of existing user interface designs in Augmented Reality



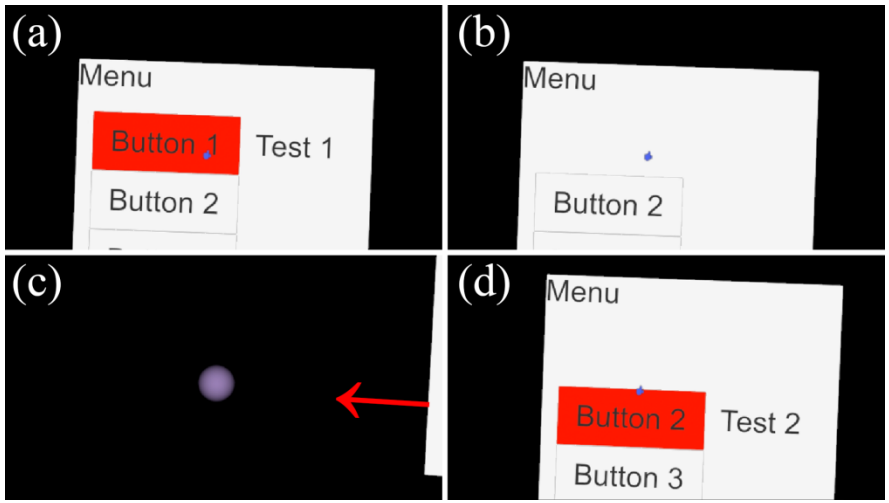
Approach

- First approach: elaborate the possibilities given by each device
  - HoloLens: using head-based pointing in combination with the tab gesture as confirmation
  - Meta 2: using the finger-based grasping to enable local interaction by touching the user interface
  - Difficulties unifying the interaction methods in a single user interface
- Solution: Using the similarities of the devices and unify the input as far as possible

Implementation

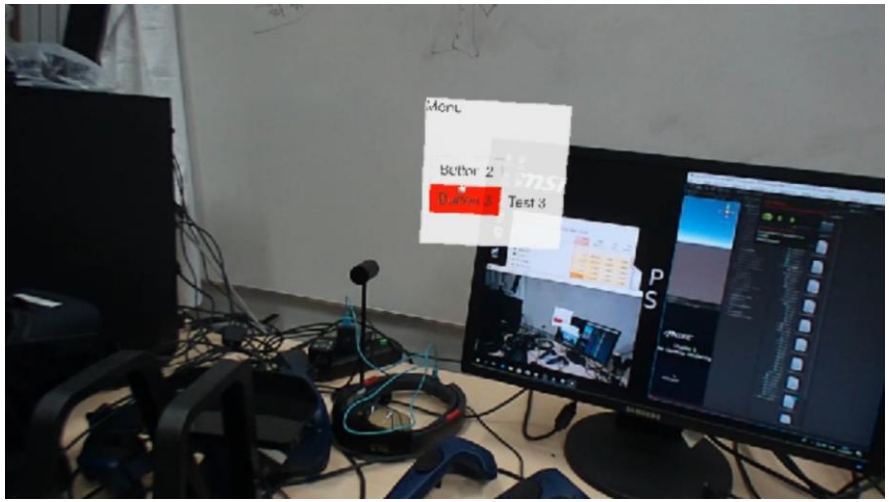
- Implementation in Unity3D
- Feiner‘s System of two-dimensional user interface windows in a three-dimensional environment as a basis for our concept
- Design of an example scene
  - Interface Script taking up the central role in managing the scene depending on the connected device
  - Self-written button script
  - Own Ray-Cast Handling

Implementation



Example use of the list with the HoloLens:

(a) Button selection
(b) Confirmation and button press by using gestures
(c) UI outside field of view
(d) UI moves into field of view



Example use of the list with the Meta 2:

- Static window displaying user interface list
- Selection through gaze
- Confirmation using a mouse click

Suggested Future Work

- Design represents a concept for implementation in future development environments

  → Integration of the main scripts into the new development environment
- New devices on the market

  → New technology may enable new possibilities in the future

  → User interfaces adjustable to new input methods and technologies

Conclusion

- Utilizing the extensive existing research and example implementations a general concept was developed
- The concept allows to use Augmented and Virtual Reality devices with the same interface

  → Implementation of a demonstrative application
- Improvement of general software support for Augmented and Virtual Reality devices

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