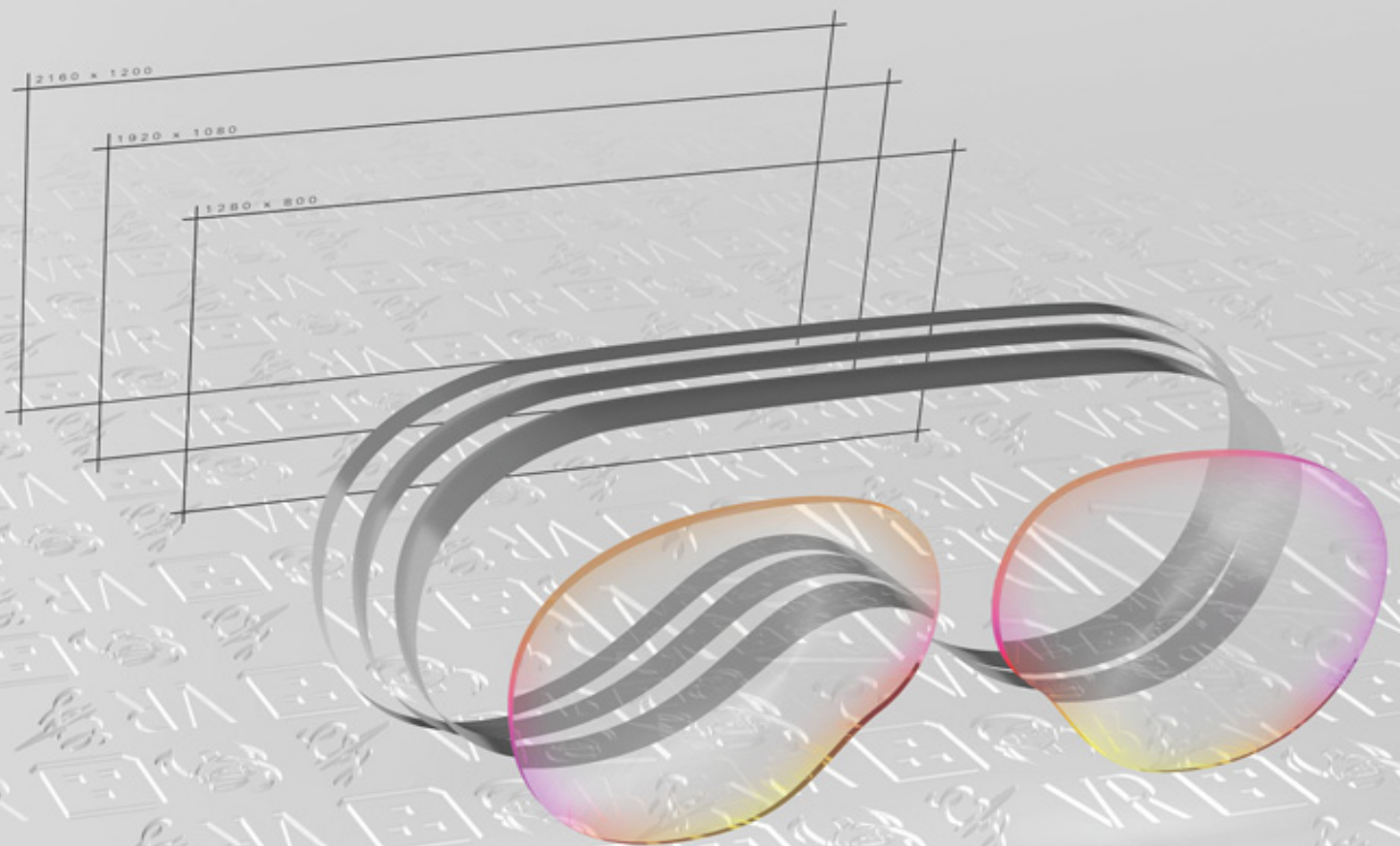


INVESTIGATING

ROLLENWAHRNEHMUNG, PERSPECTIVE AND SPACE

THROUGH

VIRTUAL REALITY RELATED GAME INTERFACES



DR. DANIEL P. O. WIEDEMANN

Dedicated to my parents
Maria Elisabeth Wiedemann & Otto Allgaier

We do not stop playing because we grow old, we grow old because we stop playing!

- *Benjamin Franklin*

Unfortunately, no one can be told what the Matrix is. You have to see it for yourself.

- *Morpheus. The Matrix (1999)*

For me, the cool thing is doing things that could only be done in gaming.

- *Warren Spector*

Immersion: The pleasurable surrender of the mind to an imaginative world ...

- *Janet H. Murray. Hamlet on the Holodeck: The Future of Narrative in Cyberspace (1997)*

ABSTRACT

This thesis describes my explorations and investigative reflections on *Rollenwahrnehmung* (a newly coined phrase meaning role perception/fulfillment), *Perspective* and *Space* through *Virtual Reality (VR)* game interfaces.

Throughout this narrative, a number of important topics, relating to my thesis, will be addressed, like the creation of new experiences in the context of *VR*, the extension and new development of various interaction paradigms, various *User Experience* aspects and user guidance in a sophisticated new medium.

My research, placed in the field of design practice, focuses on the creation of digital gaming artifacts, while extrapolating insights and guidelines concerning *VR* interfaces. Both closely intertwined strands will be discussed in the narrative context of investigating the user's *Rollenwahrnehmung*, *Perspective* and *Space*.

The thesis describes practice-based research derived from a portfolio of specifically developed interactive artifacts, following the methodological approach of *Constructive Design Research (CDR)*. These include the games *Nicely Dicely*, *LizzE - And the Light of Dreams* and *Gooze*. They were used for user testing sessions during various *Lab* experiments and *Showroom* presentations (components of the *CDR* approach), while continually being refined throughout an iterative process.

Nicely Dicely is an abstract game based on physics. In *Local Multiplayer*, up to four players are able to compete or collaborate. It is not a *VR* game per se, but features both, *Monoscopic* and *3D Stereoscopic Vision* modes. As the latter

is an important aspect of VR, this game was used to primarily investigate if *3D Stereoscopic Vision* increases *Player Immersion*, even in a possibly distracting *Local Multiplayer* game. Among further insights, the results confirmed that *Player Immersion* is increased when using a *3D Stereoscopic Presentation* compared to a *Non-3D Monoscopic* one.

LizzE - And the Light of Dreams is a *Singleplayer 3rd Person Hack and Slay* game based in a fantasy universe. The game basics were previously developed and further extended during this research. In an experiment, the game was used to primarily investigate in which ways *3rd Person VR* games can work for a broad audience. Five different *3rd Person* camera behavior modes were tested for their *Player Enjoyment* and *Support of Gameplay*, while closely looking at their influence on *Simulator Sickness*. The results led to using a default camera behavior based on the *Buffered Pulling* approach but providing users with the option to switch to a behavior based on the *Blink Circling* approach instead.

Gooze is a *1st Person VR* puzzle game, taking place in a realistic horror environment with supernatural aspects. It was designed with diverse VR interaction technologies in mind and offers users different options to play the game, depending on available hardware and preferences. In an experiment, the game was used to primarily investigate how three different interaction setups and their underlying *Locomotion* and *Virtual Object Interaction* mechanics affected several *User Experience (UX)* aspects like: *Player Enjoyment*, *Support of Gameplay*, *Simulator Sickness* and *Presence*, with the latter being subdivided into the four sub-parameters: *General Presence*, *Spatial Presence*, *Involvement* and *Experienced Realism*. The results led to a detailed comparison of individual advantages and

disadvantages of the assessed interaction modes and their mechanics.

The research is reported in three sections, one per artifact. Each section gives an overview of the artifact and documents its mechanics, style, content, feature set and discusses its design and development process. Furthermore, each section elaborates on the *Lab* and *Showroom* user studies that have been undertaken and their outcomes.

In summary, this thesis in combination with the portfolio of games, contribute to knowledge by providing three unique and documented artifacts, illustrating various game, interface and *VR* designs, extending the *CDR* approach to *VR* game development and informing the emerging field of the relationship between *UX*, interfaces and gameplay. Each single artifact and the whole collection can be used as a design and development precedent for practice and academia. Furthermore, guidelines for designing and developing specific aspects of *VR* games were identified, the experience related term of *Rollenwahrnehmung* was established in the area of *VR*, a *Hybrid Journaling Technique* was developed, using versioning commits for design reflection and an extension of *Constructive Design Research* to the field of digital games creation was undertaken. Additionally, this thesis offers a reflected rationale of different *VR* game interfaces affecting *Rollenwahrnehmung*, *Perspective* and *Space*. Eventually, it further provides an outlook on possible areas for future research, related to the overall study in a more general sense and more specific to individual artifacts and corresponding studies.

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CITATION STYLE

Throughout this thesis a form of the *Harvard* citation style is used. Inline quotes will either directly cite “the precise wording enveloped by quotation marks” or paraphrase its content and reference (Author/s date) in parentheses or directly in the text. The reference’s details can be looked up in the section *References* from page →ff.

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This might be a longer precisely worded passage or paragraph from a relevant reference, cited in a format convenient to the reader.

(Author/s date)



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A.4 AHRC - Arts and Humanities Research Council

A.5 AI - Artificial Intelligence

A.6 AMOLED - Active-Matrix Organic Light-Emitting Diode

A.7 ANOVA - Analysis of Variance

A.8 API - Application Programming Interface

A.9 AR - Augmented Reality

A.10 Artifact

A.11 Break-in-Presence

A.12 CCP

A.13 CDR - Constructive Design Research

A.14 Character

A.15 CHI PLAY

A.16 CHT - Controllerless Hand Tracking

A.17 Component - Unity

A.18 Constellation Tracking - Oculus

A.19 CPU - Central Processing Unit

A.20 CV1 - Oculus Rift Consumer Version 1

A.21 DK1 - Oculus Rift Development Kit 1

A.22 DK2 - Oculus Rift Development Kit 2

A.23 DPS - Design Practice Stream

A.24 EEG - Electroencephalogram

A.25 Experience

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A.27 FIVE - Framework for Immersive Virtual Environments

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A.29 FOV - Field of View

A.30 FPS - First Person Shooter

A.31 FPS - Frames per Second

A.32 G - General Presence

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A.35 GPU - Graphics Processing Unit

A.36 GUI - Graphical User Interface

A.37 GUID - Globally Unique Identifier

A.38 Hack and Slay

A.39 HCI - Human Computer Interaction

A.40 HDK - Hacker Development Kit

A.41 HDMI - High-Definition Multimedia Interface

A.42 HMD - Head Mounted Display

A.43 HTC

A.44 HUD - Head-up-Display

A.45 IDE - Integrated Development Environment

A.46 IDEO

A.47 Immersion

A.48 IMU - Inertial Measurement Unit

A.49 Inside-Out Tracking
A.50 Interface
A.51 INV - Involvement
A.52 IPD - Inter-Pupillary Distance
A.53 IPQ - igroup Presence Questionnaire
A.54 IQR - Inter-Quartile Range
A.55 IR - Infrared
A.56 ISO - International Organization for Standardization
A.57 Kurtosis
A.58 Lab
A.59 LCD - Liquid-Crystal Display
A.60 LED - Light-Emitting Diode
A.61 Lighthouse Tracking - Steam VR
A.62 LOC - Locomotion
A.63 LOD - Level of Detail
A.64 M - Joystick with a Monitor
A.65 MDX - Middlesex University London
A.66 Mechanic
A.67 MIT - Massachusetts Institute of Technology
A.68 Monoscopy
A.69 Motion Tracking
A.70 MPhil - Master of Philosophy
A.71 MR - Mixed Reality
A.72 MS - Microsoft

A.73 Multiplayer

A.74 NPC - Non-Player Character

**A.75 OASIS - Ontologically Anthropocentric
Sensory Immersive Sim.**

A.76 OLED - Organic Light-Emitting Diode

A.77 ONSP - Oculus Native Spatializer Plugin

A.78 OSVR - Open Source Virtual Reality

A.79 OS X - macOS

A.80 PBR - Physically Based Rendering

A.81 PC - Personal Computer

**A.82 PCIe - Peripheral Component
Interconnect Express**

A.83 PE - Player Enjoyment

A.84 Perspective

A.85 PhD - Doctor of Philosophy

**A.86 PIFF - Presence Involvement Flow
Framework**

A.87 Player Character

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A.90 PS - PlayStation

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A.92 RAM - Random-Access Memory

A.93 REAL - Experienced Realism

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A.97 RSS - Rich Site Summary
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