

Navigation in Virtual Reality Space

Concepts of Navigation Methods

**IP5 Project of**

**Bär Dominic**

**Groux Marcel**

**FHNW**

**University of Applied Sciences**

**Degree Course: Computer Science / iCompetence**

**Supervising Lecturers: Arizona Stefan, Marcin Simon**

**Windisch, 29. December 2016**

Summary

Project Summary

Preface

Vorwort

Index

1 Introduction 4

1.1 What has been achieved? 4

1.2 Why has it been done? 4

1.3 How has it been achieved? 4

1.4 Readers Guide: How is the rest of the document constructed? 4

2 Initial Position 5

2.1 Introduction 5

2.2 Application domain 5

2.3 Overall scenario 5

2.3.1 Target audience 5

2.4 Project Goals 5

2.4.1 Navigation Methods 5

2.5 Project Scope 6

2.6 Limitations and Assumptions 6

3 Research 7

3.1 Introduction 7

3.2 Problem 7

3.3 Navigation Methods 7

3.3.1 Walking 7

3.3.2 Teleporting 9

3.3.3 Other Methods 10

3.3.4 Parameters 11

3.4 Technical Research 11

3.4.1 Game Engines 11

3.4.2 Unreal 11

3.4.3 VR Headsets 11

4 Suggestions 13

5 Implementation 14

5.1 Introduction 14

5.2 Implementation of the Navigation Methods 14

5.3 Hardware 14

6 Results 15

6.1 Introduction 15

6.2 Test Results 15

7 Conclusion 16

7.1 Introduction 16

7.2 Insights 16

7.3 Clarifications 16

7.4 Suggestions 16

8 Reflexion 17

8.1 Introduction 17

8.2 Lessons Learned 17

8.2.1 Dominic Bär 17

8.2.2 Marcel Groux 17

8.3 Time Management 17

8.4 Reflexion Collaboration 17

8.4.1 Team Internal Collaboration 17

8.4.2 Collaboration with Coaches / Clients 17

9 Index of Literature 18

L1. Literature 18

L2. Internet 18

L3. Interviews 18

10 Index of Figures 19

A. Attachment 20

A1. Attachment 1 20

A2. Attachment 2 20

A3. Attachment 3 20

A4. Clarification of Honest 20

1. Introduction

This chapter contains an overview of the project. It describes what has been accomplished with the project and which topics are covered.

## What has been achieved?

Was wurde mit dem Projekt erreicht.

* Im Rahmen des Projektes wurden Prototypen zu Navigationsmethoden im VR Space erstellt
* Kurze Beschreibung der Prototypen

## Why has it been done?

Aus welchem Grund wurden die Prototypen erstellt?

## How has it been achieved?

Neue Technologie 🡪 Explorativer Ansatz (Ausprobieren, Entwickeln, Ausprobieren, etc)

Game Engine Unreal

## Readers Guide: How is the rest of the document constructed?

Zwei Teile

1. Theoretisches:
   1. Fragestellug
   2. Research
   3. Navigation Methods
2. Praktisches
   1. Implementation Prototypes
   2. Tests
   3. Results
3. Initial Position

## Introduction

In this chapter the initial position of the project will be introduced. The Application domain will be described and an overall scenario will be shown. Furthermore, the project goals and scope will be stated.

## Application domain

Anwendungsdomäne

## Overall scenario

Big Picture

Um was geht es im Projekt? Navigationsmethoden in vr

Was ist das schlussendliche Ziel? Erstellung von prototypen zur analyse der Methoden

### Target audience

Zielpublikum

-> Entwickler von VR Applikationen / Games

## Project Goals

The goal of this project is the generation of a concept about the navigation in the Virtual Reality space. The concept is based on a scientific research and should address the questions of the suitability for different navigation methods and the corresponding parameters (e.g. camera angle/area, scaling in space, …) within specific scenarios, which are to be determined.

Finally, the concept contains a thorough scientific analysis of VR navigation and its parameters, elaborated in a scientific approach and reflecting the current state of research of the Virtual Reality Community as far as possible.

The navigation methods, elaborated in the concept, should be implemented as a template for different scenarios and be tested thoroughly. Such that it can be shown which navigation methods are suited best for different scenarios. Thereby it is to bear in mind that the navigation that we are reviewing should be possible to use in a home-user-environment.

### Navigation Methods

The elaborated Navigation methods:

* Various variants of walking
  + Walking
  + Walking in Place
  + Scaled Walking
  + Dynamic Walking
  + Walking by leaning)
* Jumping

## Project Scope

Aufgabenstellung

Schwerpunkte der Arbeit

## Limitations and Assumptions

Welche Einschränkungen mussten wir machen?

* Einschränkung der NavMet (Zeitlich niemals alle möglich)

Welche Annahmen mussten wir treffen?

1. Research

## Introduction

In this Chapter we discuss the problem of our project and show results of our research in the field of the application domain

## Problem

The community provides a variety of implementation and methods for the navigation in the Virtual Reality space. Many of those however couldn’t be tested and analyzed scientifically. Furthermore, the already existing scientifically elaborated concepts are not necessarily suited for the new VR Hardware and the User- Space available for the VR-setup, like the HTC Vive or the Oculus Rift, and the usage in a productive application with users that have varying know-how and experience in Virtual Reality.

## Navigation Methods

Auflistung der Navigationsmethoden (siehe seperates Dokument für NavMethod / Parameters)

Unterteilt in Walking und Teleporting

Specify physical translocation and / or movement?

Change tables vertically?

|  |  |
| --- | --- |
| Description | The user walks inside a given space |
| Physical Translocation | Yes |
| Physical Movement | Yes |
| Parameters | * Location * Speed * Acceleration * Deceleration * Camera Direction |
| Problems | * Wall Collision |

### Walking

#### Walking

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Description | Physical Translocation | Physical Movement | Parameters | Problems |
| The User walks inside a given space | Yes | Yes | * Location * Speed * Acceleration * Deceleration * Camera Direction | * Wall Collision |

#### Walking in Place (WIP)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Description | Physical Translocation | Physical Movement | Parameters | Problems |
| The user walks in place | No | Yes | * Speed * Acceleration * Deceleration * Camera Direction | * Wall Collision * When does it start to walk? * Motion sickness |

#### Scaled Walking

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Description | Physical Translocation | Physical Movement | Parameters | Problems |
| The user walks inside the given space. The physical translation in the VR-Space is scaled up. | Yes | Yes | * Location * Speed * Acceleration * Deceleration * Camera Direction * Scaling | * Wall Collision * Motion sickness * Scale-rate |

#### Dynamic Walking

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Description | Physical Translocation | Physical Movement | Parameters | Problems |
| The user walks like in scaled Walking. The intention of the user is detected. | Yes | Yes | * Location * Speed * Acceleration * Deceleration * Camera Direction * Scaling | * Wall Collision * Motion sickness * Scale-rate |

#### Auto Walking

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Description | Physical Translocation | Physical Movement | Parameters | Problems |
| The user looks down at his feet and starts to walk. | No | No | * Speed * Acceleration * Deceleration * Scaling | * Wall Collision * When does it start to walk? * When does it stop to walk? * Motion sickness * Scale-rate |

#### Walking by Leaning

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Description | Physical Translocation | Physical Movement | Parameters | Problems |
| The user leans towards the direction he wants to walk. | No | Yes | * Location * Location (Head) * Speed * Acceleration * Deceleration * Camera Direction * Scaling | * Wall Collision * Detection of leaning * Motion sickness * Scale-rate |

#### Walking by Button

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Description | Physical Translocation | Physical Movement | Parameters | Problems |
| The user walks by pressing a button. | No | No | * Speed * Acceleration * Deceleration * Scaling | * Wall Collision * Motion sickness * Scale-rate |

### Teleporting

#### Gaze-directed Teleport

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Description | Physical Translocation | Physical Movement | Parameters | Problems |
| The user Looks to a point where he wants to teleport to. He teleports by clicking a button | No | No | * Location * Camera Direction * Speed of Teleport | * Camera Direction after teleport (Wall collision) * Camera transition |

#### Pointed Teleportation

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Description | Physical Translocation | Physical Movement | Parameters | Problems |
| The user points towards a location he wants to teleport to. He teleports by clicking a button. | No | No | * Location * Camera Direction * Speed of Teleport | * Camera Direction after teleport (Wall collision) * Camera transition |

#### Room-to-Room-Teleportation

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Description | Physical Translocation | Physical Movement | Parameters | Problems |
| The user points towards a room he wants to teleport to. He teleports by clicking a button. The location inside the room is dependent of the current location inside the room | No | No | * Location * Camera Direction * Speed of Teleport | * Combining with other method (Walking, WIP, etc) * Camera transition |

#### Zoomed Teleportation

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Description | Physical Translocation | Physical Movement | Parameters | Problems |
| The User looks into the direction he wants to go. He teleports by clicking a button | No | No | * Location * Camera Direction * Speed of Zooming | * Camera transition |

#### Jumping

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Description | Physical Translocation | Physical Movement | Parameters | Problems |
| The user jumps in place. | Yes | Yes | * Location (Head) * Camera direction * Scaling | * Mostly needs to be combined with another method (Walking, WIP, etc) |

### Other Methods

#### Climbing

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Description | Physical Translocation | Physical Movement | Parameters | Problems |
| The user climbs by using his hands to pull him upwards. | No | Yes | * Location (Head) * Camera direction * Scaling | * Mostly needs to be combined with another method (Walking, WIP, etc) |

#### Flying

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Description | Physical Translocation | Physical Movement | Parameters | Problems |
| The user flies by using his hands / Controllers to navigate horizontally and vertically | No | Yes | * Location * Camera direction * Speed * Acceleration * Deceleration * Scaling | * Wall collision * Motion sickness * Scale-rate * When does it start to fly? |

#### Flying II

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Description | Physical Translocation | Physical Movement | Parameters | Problems |
| The user navigates in a 3D-Space by pressing buttons. | No | No | * Camera direction * Speed * Acceleration * Deceleration * Scaling | * Wall collision (?) * Motion sickness |

#### Guided Navigation

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Description | Physical Translocation | Physical Movement | Parameters | Problems |
| The user follows a given path and needs to adjust to given parameters by using his hands / controllers | No | Yes |  |  |

### Parameters

Add Description to each parameter

• Location (X- / Y- / Z-Axis) (Head-Gear)

• Location (X- / Y- / Z-Axis) (Hand-Controller)

• Camera Direction

• Camera Angle

• Speed

• Acceleration

• Deceleration

• Scaling

• Brightness / Darkness

• Sound of movement

## Technical Research

Research bezüglich der Technologie

### Game Engines

Eventuell Kapitel 4.4.1.3, welches beschreibt, warum wir unreal gewählt haben?

#### Unity

Unity is a cross-plattorm game engine developed by Unity Technologies. It is commonly used for the development of video games for computers, consoles and mobile devices. […]

Add more details

### Unreal

Description of Unreal

### VR Headsets

#### HTC Vive

Description of HTC Vive

#### Oculus Rift

Description of Oculus Rift

# Suggestions

Konzept Suggestions which NavMet where to use

Entwicklungsprozess

# Implementation

## Introduction

Praktische umsetzung, protyping process

Concept and ideas

## Concepts and ideas

### Walking in Place

Text

Redo Image, with english text (like jumping and Scaled Walking)

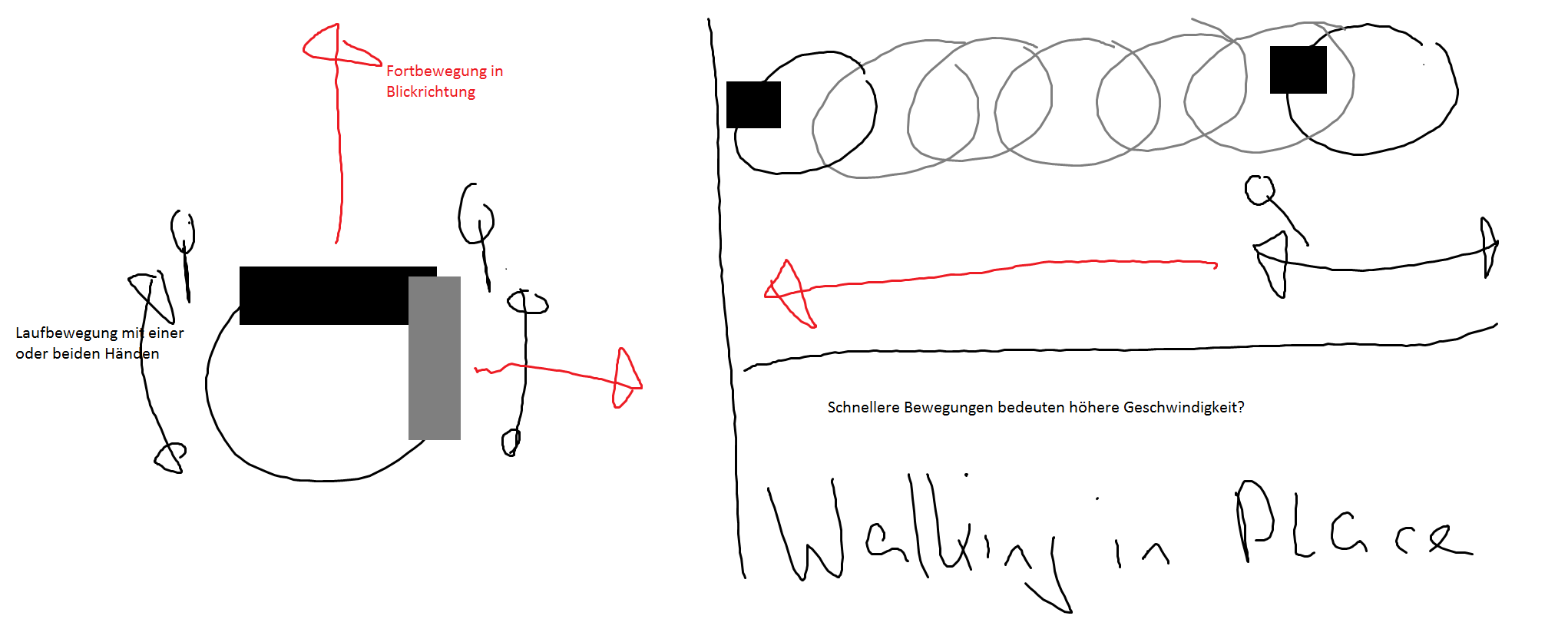


Figure 1 - Walking in place concept draft

### Scaled Walking

Text



Figure 2 - Scaled walking concept draft

### Walking by Leaning

Text

Redo Image, with english text (like jumping and Scaled Walking)

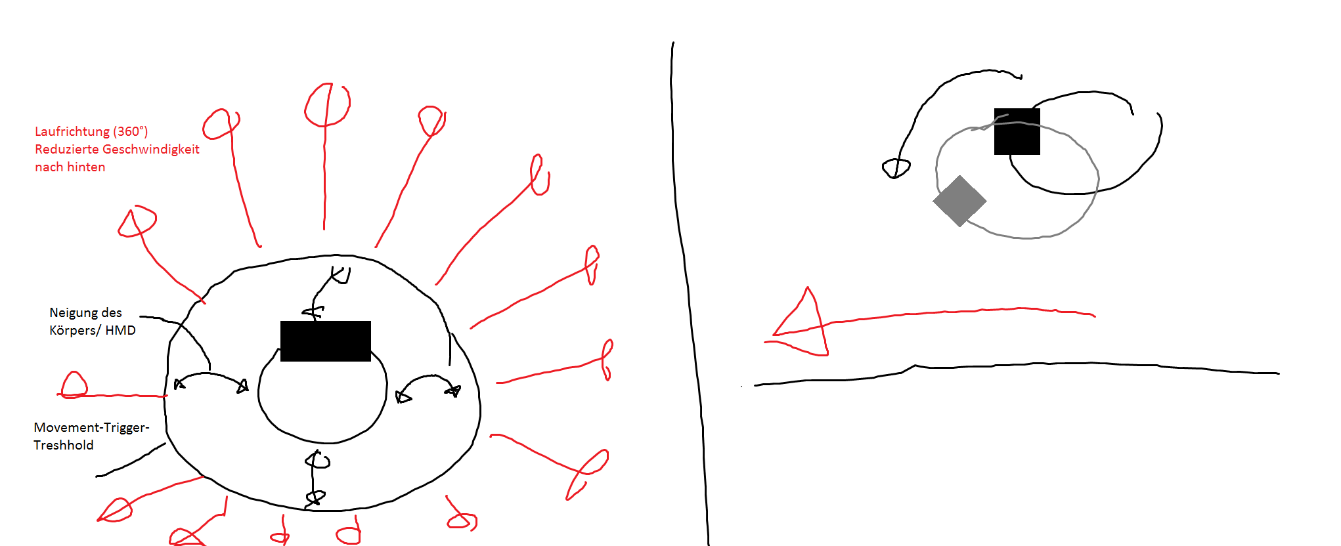


Figure 3 - Walking by leaning concept draft

### Jumping

Text



Figure 4 - Jumping concept draft

## Implementation of the Navigation Methods

Unterteilung nach NavMet?

Creation of prototypes

## Hardware

Which hardware we use and why

-> HTC Vive

# Results

## Introduction

Introduction to the testing, what has been tested, how has it been tested, etc

## Test Results

Detailreich auf Ergebnisse eingehen

Prototypen

Test Results to the tests for each prototype

Survey results (= Test results?)

# Conclusion

## Introduction

Fazit

## Insights

Welche Erkenntnisse haben wir gemacht?

## Clarifications

Was gibt es zu erklären?

## Suggestions

Empfehlunen für weiter Projekte

# Reflexion

## Introduction

In this chapter we reflect on our project work. We will talk about what we have learned / gained, what was good or bad and out time management. Furthermore, we will reflect on the collaboration within the team and with the coaches.

## Lessons Learned

Persönlicher Lerngewinn

### Dominic Bär

Lessons Learned Dominic

### Marcel Groux

Lessons Learned Marcel

## Time Management

Wie sind wir mit dem Zeitmanagement zufrieden, verbesserungen?

Herausforderung

Aufwandabschätzung schwer, da vieles noch unbekannt

Zu wenig Puffer

Viel Zeit für Einarbeitung der Technologie (unreal) benötigt

## Collaboration

### Team Internal Collaboration

Wie hat die Zusammenarbeit im Team funktioniert

### Collaboration with Coaches / Clients

Wie hat die Zuammenarbeit mit Stefan und Simon funktioniert

# Index of Literature

L1. Literature

List all physical literature we used, (Did we use any?)

L2. Internet

Add all used researched papers, stated with visiting date etc. (Savedate as visiting date, or how to handle?)

# Index of Figures

Index of all figures that will be in the text.

[Figure 1 - Walking in place concept draft 14](#_Toc470809079)

[Figure 2 - Scaled walking concept draft 15](#_Toc470809080)

[Figure 3 - Walking by leaning concept draft 15](#_Toc470809081)

[Figure 4 - Jumping concept draft 16](#_Toc470809082)

1. Attachment
   1. Attachment 1

Project Agreement?

* 1. Attachment 2

Test Survey, with anaysable results?

* 1. Attachment 3

?

* 1. Clarification of Honest

To be written