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Bachelorarbeit

User Guidance in Virtual Reality

Joan Lechner

Aufgabensteller:	Prof. Dr. Dieter Kranzlmüller
Betreuer:	Markus Wiedemann
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München, den 23. Mai 2019

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Abstract

While user guidance and tutorials remained a largely untouched area of research thus far, this thesis focuses on capturing the current approaches and related challenges surrounding user guidance in virtual reality (VR). In order to analyze current VR applications and their respective approaches to user guidance, a user study in the form of a questionnaire was conducted. Based on the studies results and additional research, a checklist consisting of 21 items across 6 categories was created. With the help of this checklist, 11 applications were analyzed. The checklist's results showed that many applications lacked user guidance in areas such as safety, movement or user motivation, while other information including basic control schemes seem to be addressed by the majority of applications analyzed. The checklist also indicated text to be one of the preferred forms of conveying user guidance to the user. On the basis of these findings, this thesis encourages further research into the subject matter, specifically by expanding the number and variety of analyzed applications in addition to further studies focusing on the effects of user guidance with regards to VR.

Zusammenfassung

Während der Bereich der Nutzerführung bisher weitgehend unerforscht blieb, konzentriert sich diese Arbeit auf das Erfassen aktueller Ansätze und die damit verbundenen Herausforderungen rund um die Nutzerführung in der virtuellen Realität (VR). Um eine Methodik zu Analyse aktueller VR-Anwendungen und ihre jeweiligen Ansätze zur Nutzerführung zu erstellen, wurde eine Nutzerstudie in Form eines Fragebogens durchgeführt. Basierend auf den Umfrageergebnissen und weiteren Recherchen wurde eine Checkliste mit 21 Elementen aus 6 Kategorien erstellt. Mit Hilfe dieser Checkliste wurden daraufhin 11 Anwendungen analysiert. Die Ergebnisse der Checkliste zeigen, dass vielen Anwendungen die Nutzerführung in Bereichen wie Sicherheit, Bewegung oder Nutzermotivation fehlt, während andere Bereiche wie beispielsweise grundlegende Steuerungsschemata, von der Mehrheit der analysierten Anwendungen angesprochen zu werden scheinen. Eine Analyse der Checkliste ergab ausserdem, dass Text eine der bevorzugten Formen zur Vermittlung von Informationen an den Nutzer zu seien scheint. Auf der Grundlage dieser Ergebnisse befürwortet diese Arbeit weitere Forschung, insbesondere durch die Analyse weiterer und unterschiedlicher Anwendungen, sowie durch zukünftige Studien die sich auf die Auswirkungen von Nutzerführung speziell in Bezug auf VR konzentrieren.

Contents

1. Introduction

1.1. Overview

Even though first concepts of virtual reality systems date back as far as the 1950s, virtual reality (VR) has recently gained more attention due to companies like Sony and HTC releasing first consumer versions of their VR systems in 2016. Today VR presents itself as a growing market, with VR systems being used across various fields such as education, gaming and psychological therapy. Being a unique medium, VR systems and applications manifest unique features such as new control paradigms and an unparalleled immersion, which developers have to take into consideration while developing for VR. Back in the early 1990s Bricken and Bryne [BB93] ascertained that "VR eliminates the traditional separation between user and machine, providing more direct and intuitive interaction with information. [...] We can create virtual worlds and step inside to see, hear, touch and modify them."

As the range of hardware and software quickly expands, many systems struggle introducing users to the new medium and its conditions. Many applications rely on older ways of introducing and guiding the user (e.g. classic video game tutorials), which often are not tailored to specifically fit VR applications. This seems to, in part, come as a consequence of user guidance with regards to VR being a mostly unaddressed area of research.

In contrast to other, more established mediums, VR often presents the additional necessity of explaining the medium itself before even being able to address topics like application specific controls. This thesis aims to provide a basis of knowledge about the medium of VR itself as well as the principles of user guidance used. The goal is to highlight the areas where VR presents unique challenges and which advancements have been made thus far.

1.2. Outline

Chapter 2 will give a basic overview of VR as a medium, giving the necessary information in terms of hardware and software as well as definitions of important terminology. In the subsection "User Guidance" we will investigate multiple principles of existing user guidance. Chapter 3 specifically investigates existing tutorials for VR to give insight into current approaches to VR applications. Chapter 4 presents the results of the questionnaire given out as part of this thesis, followed by the checklist which gives an overview of 11 VR applications' approaches to user guidance. Chapter 5 will conclude this thesis and give an overview on possible future work into the area of immersive user guidance in VR.

2. Basics and Common Problems of VR

2.1. Defining VR as a Medium

2.1.1. Systems and Hardware

VR systems are generally speaking computer systems, which generate a three-dimensional, real time rendering of a virtual environment. These environments are then conveyed to the user via a visual output device, in most cases VR glasses. This sets VR apart from other systems. The glasses or head mounted displays (HMD) completely block out the real world from the user and only display the virtual world, limiting the user's visual perception to the virtual environment. Depending on system and software, one or more input devices as well as additional peripheral hardware or props can be used to manipulate the virtual environment. The peripheral hardware can consist of traditional game pads, custom VR controllers, haptic feedback gloves or suits.

While most VR systems have certain hardware like the HMDs in common, a distinction has to be made between tracked and untracked systems. Untracked systems, which often utilize mobile devices for computing and displaying content (e.g Samsung Gear VR[1]), work without tracking the users position or actions relative to the actual physical space the user is in. These versions of VR can translate some of the users smaller movements, for example head movement while looking around, into the experience, but they can not account for spacial movement like walking.

Tracked systems on the other hand, use cameras or sensors to put the user in relation to the physical space. This is achieved by tracking the HMD and any of the peripheral hardware, as well as pre-defining the real world space the user can move in. This allows the system to translate any real movements into the virtual environment. This thesis will focus on the tracked systems since these systems generally allow for more user interaction and hence require more user guidance.

2.1.2. Applications and Software

VR applications and their content vary greatly. Applications can be 360 degree videos, interactive video games, three-dimensional visualizations of other software like CAD, or passive experiences with minimal to no interaction by the user. Especially with regard to video games, software can be specifically engineered for VR or just be an adaptation of existing games. As mentioned by Reuters in the summary of iGATE research report titled "Global Virtual Reality Market (Hardware and Software) and Forecast to 2020" [IGa17][2] video games make up a large portion of the currently available applications for VR.

[1] https://www.samsung.com/global/galaxy/gear-vr/
[2] https://www.reuters.com/brandfeatures/venture-capital/article?id=4975 [accessed: 11.12.2018]

2.2. Immersion

Since there exist multiple definitions of the terms “immersion” and “presence” and some literature even uses the terms as synonyms, throughout this thesis “immersion” will refer to the technological features delivered by a VR system, whereas the term “presence” refers to the way and degree a systems output is perceived by a human. Presence will be defined in the following section).

Slater’s[Sla03] approach to separate the terms focuses on the fact that immersion, contrary to presence, can be objectively measured. Immersion for example refers to features like the resolution or the rendering capabilities of the system. This also means systems can be compared with respect to immersion.

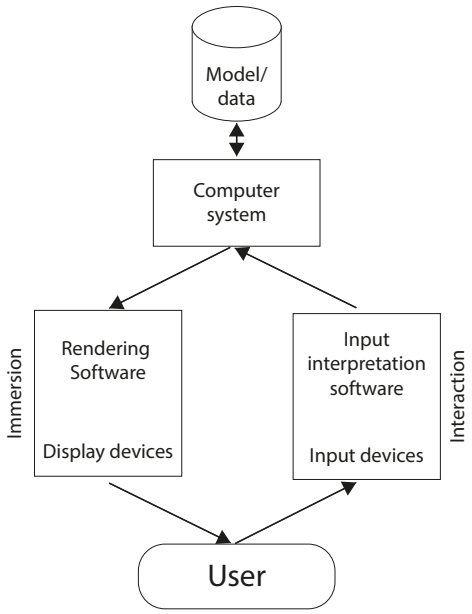

Figure 2.1.: Human Interaction loop. Showing immersion only refers to the display devices and rendering software of the system

2.3. Presence

One of the most obvious distinctions between VR and other mediums is the level of presence that can be achieved by VR. Although there is not just one definition, presence or telepresence is often referred to as the human experience and perception within a VR system. According to Steuer [Ste93], presence in general can be defined as “the natural perception of an environment” whereas telepresence “refers to the mediated perception of an environment. This environment can be either a temporally or spatially distant “real” environment (for instance, a distant space viewed through a video camera), or an animated but non-existent virtual world synthesized by a computer (for instance, the animated “world” created in a video game)”. So with regards to VR, at any moment a user experiences two types of presence, the state “V”(the virtual environment created by the system) and state “R”(the real world and physical space) [MS00]. Slater and Anthony outlined presence as follows. “At

each moment, the individual will tend towards one rather than the other. Presence in the VE – virtual presence – may be thought of as the extent to which the interpretation V is favored", [MS00].

2.4. Breaks in Presence

Following the definition of presence we can outline what a break in presence (BIP) is and when it occurs. According to Slater and Steed [MS00] a BIP occurs when a user becomes more aware of the real world(or before mentioned state "R") than the virtual environment, thus breaking the presence. A BIP can be caused by different circumstances. One being a real-world influence like sounds of the surroundings or being touched by someone. If these influences do not match or even contradict the virtual environment a BIP occurs. The other major reason for a BIP to occur is when parts of the application and therefore the digital environment itself are out of place, reminding the user of the environment's virtual and constructed nature.

Suppose a user enters an application that depicts some form of a real world scenery. Over time, the animations, sounds and the level of detail captivate the user to a point where they are mostly oblivious to the real surroundings. If the need arises to convey information or instructions to the user, and the developers chose to do so by simply displaying text as a pop-up (common in video game tutorials [Whi14]), the user's sense of virtual presence might immediately break. Since there is no such thing as text-pop ups in the real world, the user could potentially no longer perceive what he is experiencing as real (the state V is no longer favored).

Another cause for a BIP can be a discrepancy between what the user expects from an application and what is actually possible. These causes for BIPs can be hard to prevent, since expectations usually stem from prior knowledge or experience. Not only do expectations vary from user to user, but due to VR being such a new medium users often have no prior experience with VR systems, but rather derive their expectations from other mediums such as traditional video games or movies.

One example for such a case could be as simple as the user wanting to pick up a virtual item. If the user assumes an item can be picked up but then is not able to, because the developers did not make the item in question intractable, the user can potentially experience a BIP. The inability to perform certain actions, especially actions possible in the real world, are an instant reminder of the non-real nature of an VR application and can therefore be the cause of a BIP.

With the sense of presence being a key component, creating and preserving presence is one of the biggest challenges while developing for VR.

2.5. User Guidance

For the purpose of this thesis, user guidance will refer to any form of direct or indirect assistance to a user. This assistance can be presented in the form of audio and visual or any other sensory aid.

While other mediums like game consoles, smartphones or computers have well established and mostly universal control schemes and means of input, VR systems offer new control paradigms. Being a fairly new medium, there are no such universal or common schemes that

apply across different systems and applications. This requires users to constantly adapt, or even relearn controls as well as mechanisms. To establish new controls or help newer users, developers usually provide tutorials or manuals to facilitate operation. In the case of VR, this can prove difficult for at least some applications, since most traditional forms of tutorials disrupt the before mentioned sense of presence in VR. As of the time this thesis is being written, there has not been a lot of specific research conducted with regard to tutorials in VR. When researching the topic of tutorials however, one will inevitably come across video game tutorials in the context of game design and Human Computer Interaction (HCI), since more extensive research has been carried out in these areas.

While tutorials in video games may also try to explain some facts about the game's world or story, many tutorials and manuals focus on the topic of controls and safety. Further focus lies on showing the user how to setup, operate and in some cases troubleshoot a system, machine or software. This is true for printed manuals that come with hardware like dishwashers, washing machines or TVs as well as digital tutorials for software like games.

With a large portion of VR applications being video games, VR tutorials often derive from game tutorials. This thesis will not try to rate the benefit of tutorials as such, but rather explore how they could be designed if they are implemented within a VR application.

2.5.1. Manuals

A manual (also user-manual or instruction-manual) is a printed or digital document containing all information necessary for a user to make use of at least the main functionalities of a system, software or device. A manual includes information about the controls, included functions and procedures of the respective appliance. Manuals usually are made up of written instructions and explanations which can be accompanied by associated graphics, illustrations or images to convey more detailed information.

2.5.2. Video Game Tutorials

Today there are countless video games available to the consumer, with platforms like Steam listing more than 780 million games for computers alone, and more being added daily[3]. Many of these games, in some form or another, include a tutorial. The below discussed tutorials are referred to as in-game tutorials, which in contrast to manuals that come with the game, are part of the game itself. Although there does not seem to be scientific consensus on video game tutorials in general and the types there of, for this thesis we will try to group video game tutorials in three general categories:

- Tutorial by exposure – These tutorials focus solely on providing the user with instructions, often without requiring any user interaction. Such tutorials also do not have to fit in the context, since they are a pure display of information. While this type of tutorial predominantly relies on visual displays like text and graphics, it is often used in the form of hints that are displayed during loading screens or can be found in most games menus, where they are constantly accessible to the user.
- Tutorial level – The so called tutorial level or tutorial room can be utilized as an introduction. The tutorial level is a separate environment not connected or necessarily

[3] https://www.forbes.com/sites/erikkain/2014/04/17/nearly-37-of-all-registered-steam-games-have-never-been-played/#463e67402146 [accessed: 11.12.2018]

related to the rest of the game. Tutorial levels are usually not relevant to scores and there are no time constraints or failure conditions. A common technique used in tutorial levels is to disable all controls that are not currently being explained to the user, to emphasize the current explanation and avoid unwanted interaction and confusion. Additionally, many tutorial levels follow a "step by step" approach, prompting the user to follow instructions and only advancing the tutorial if the task is completed by the user.

- Embedded tutorial – Embedded tutorials can include elements of the other two types, but are distinct in that these tutorials try to conceal the fact that they are tutorials. For example text and visual prompts may be used, but tied into the games' world if the setting and circumstances allow it. Also instructions could be directed at the player but be disguised as conversations within the game world. Another feature of embedded tutorials is that they can be contextual and therefore split into multiple separate tutorials part, only teaching the user controls or game mechanics when they become relevant.

It should be noted, that a tutorial does not have to be exclusive to one of the above mentioned types. In fact, many tutorials combine certain aspects. A good example for this can be seen in Figure 2.2. While the first level of the game shown in this screenshot is a tutorial level which exhibits characteristics like the "step by step" approach, the developers also made use of static text prompts which are often associated with tutorials by exposure. Additionally, almost every game, regardless of its approach to user guidance provides a summary of the controls and other hints (usually in written form similar to digital manuals or tutorials by exposure) to the user. Typically, this information can be accessed through the games menu.

Another distinction regarding video game tutorials has to be made between mandatory and non-mandatory tutorials. While all types of tutorials can be designed to be either mandatory or non-mandatory, certain tutorial types are more suitable to be mandatory (e.g. embedded tutorials). Tutorial levels on the other hand are often non-mandatory; meaning they can be skipped by the user.

2.5.3. External assistance

This form of user guidance can be compared with the concept of an instructor. It usually consists of human to human interaction, with the instructor accompanying the user during the usage, giving initial explanations and providing assistance if needed. This requires the instructor to be familiar with the task and, ideally, with common mistakes or obstacles. External assistance can be given in the form of verbal explanations or physical assistance (e.g. in VR this can mean grabbing the user by the shoulders and turning them in a certain direction, helping the user to locate a point of interest in the virtual environment). This means that, especially if the external assistance is provided by a human, these kinds of tutorials are not necessarily predetermined and can be adapted by the "instructor", making them very versatile.

What clearly separates this form of guidance from others is the fact that the developer has no control over it. The amount and extent of the instructions provided as well as their delivery vary greatly and depend on the respective instructors.

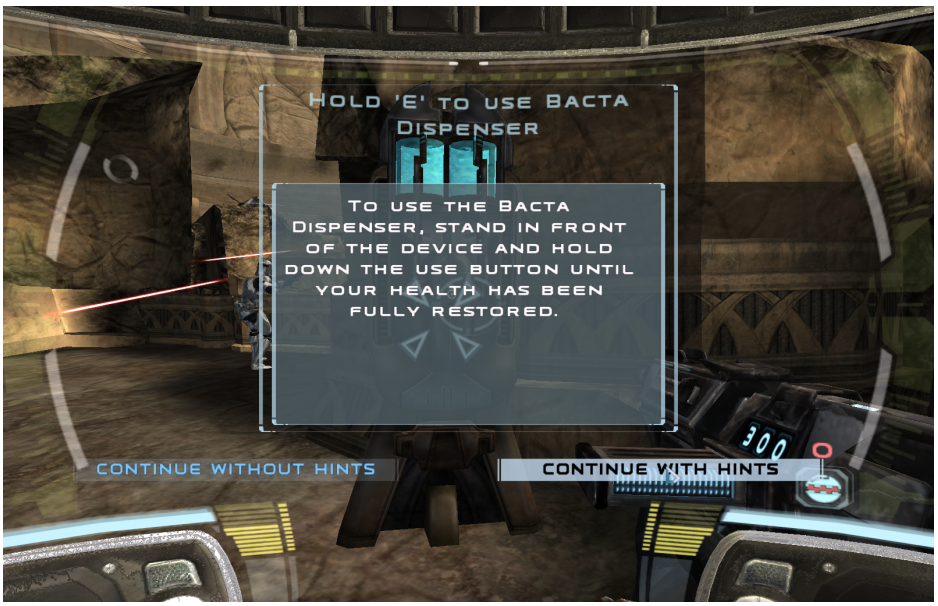

Figure 2.2.: Screenshot of the first (tutorial-) level in the video game Star Wars Republic Commando - this shows the first instructions being given to the player by the game. The game is paused and a text prompt containing information about the game's controls is displayed. To advance the game the user has to confirm the instructions by either requesting further instructions (continue with hints), or disabling future tutorials (continue without hints) for the game.

2.6. Common Problems of VR

To better illustrate why there is a need for user guidance in VR, this section lists potential problems that can occur across various VR applications and platforms.

A common practice with many current applications concerning tutorials in VR is to skip tutorials entirely or design them very curt. This usually aims to give the user a sense of exploration not only of the application but the medium itself. The developers intention often seems to be the desire not to harm the immersion. Unfortunately, this can lead to confused and irritated users, especially combined with the unique and unfamiliar means of controlling VR applications and system mentioned below.

Not all applications display an accurate 3D model of the controller in the virtual environment. A user, unfamiliar with the control scheme and/or the input device might not be able to visually check which button is being referenced. If there is a lack of visual reference and confirmation this could lead to confusion even if applications try to clarify the controls. In contrast to traditional controllers, which feature relatively established control schemes and are usually labeled and/or color coded, this means additional explanations (e.g visual via animations or highlights) are necessary to convey the information to the user.

One of the most unique features of VR, the possibility to physically move around in space, can be completely overlooked by inexperienced users due to the fact that many current applications do not provide complete character models. Many applications only display the

users avatars as upper body and hands, so it does not occur to many users that they can move at all, nevertheless by moving in the real environment. Another potential problem with the possibility of free physical movement is that no matter how much space the system has available, the user has to be restrained at some point. So not only does the system have to constantly check the user's position in relation to the physical bounds of the system, but there has to be a way to stop the user from leaving the predefined tracked space. Current solutions can include some form of barrier being displayed or text popups being shown if the user comes to close to the defined bounds. While safety is the number one priority concerning this issue, it would be beneficial to the immersion of the system to find ways that guide the user but do not cause a BIP.

The level of immersion is difficult to asses for new users. Instructing users to push a button in VR, leaves them with multiple options. Depending on the user's previous experiences, a user might try to push a button on the controller. Other users might look for a button in the virtual environment and try to push it with the controller as an extension of their hand, or they might try to push the virtual button with their physical hand. While this creates a variable in how the users might respond to instructions, it also matters what the application expects from the user. Another problem, especially among inexperienced users, is the fact that upon experiencing any kind of application for the first time, the user generally does not know what to expect. Verbally explaining a functionality like flight or teleportation can leave users ignorant about what to expect. Paired with the level of presence that can be experienced in VR this can lead to inhibitions by the users.

A majority of these issues are not exclusive to inexperienced users, since the before mentioned lack of unified control schemes and input devices across platforms and applications demands constant adaptation.

Across all mediums, the user demographic or targeted user group affects the design of soft- and hardware. The same is usually true for VR. But identifying the right target group can be hard for developers, especially in this early stage of the medium where many applications aim to showcase the potential of VR and engage users without having a specific target audience in mind. Also, certain applications that initially seem to have a clear and specific demographic, for example because of their similarity to applications on other mediums (i.e video games or genres), may have a changed demographic because of different aspects VR provides. Due to the increased immersion, a whole new demographic could be interested in an application, putting things like setting or story second. While these circumstances provide a big opportunity for developers, they can also lead to problems if they are not aware of them.

Overlooking a user group or targeting the wrong demographic, usually affects the entire application including the tutorial. If this is the case, entire groups of users could be unable to properly use an application or even be unable to use an application at all. One example for this could be an application that is approved without age restrictions, therefore suitable for all age groups, but was developed without specifically having a young audience in mind. Such an application could for example only be available in English. Additionally the introduction and explanations might only be available in written form and accessible through a menu. Younger users, which might overlook text boxes in menus and anyone not proficient reading English could be unable to make use of the application without further external assistance.

3. Methodology

Since, as of the time this thesis is being written, there seems to be a lack of research (and subsequently scientific literature) on the area of user guidance in VR, this thesis will try to lay some groundwork regarding the subject matter. Therefore, the following chapter will look at existing VR applications and their approach to user guidance. The goal is to objectively analyze the applications with regards to user guidance and give an overview of current approaches. The investigated applications were chosen to represent a cross section of the currently available VR applications. The selection includes applications from multiple categories including gaming, 3D modeling and in the case of "SteamVR Tutorial" and "Oculus First Contact", standalone tutorials for a VR system.

3.1. Current Approaches to User Guidance in VR

This section will look at a few different types of VR applications including games and modeling software and look at how they implemented user guidance. The goal is to identify different designs and strategies of implementing user guidance based on a cross-section of the currently available applications.

3.1.1. SteamVR Tutorial

SteamVR Tutorial is a somewhat unique application in that it is a HTC Vive exclusive standalone tutorial developed by the company "Valve"[1], available via their platform "Steam". This application is a circa 10 minutes long tutorial which explains the general control paradigm of the system independent of specific applications. This application is aimed at first time users of the Vive system.

For a better understanding the following will refer to "steps", in order to illustrate the different sections of the tutorial:

Step 1: The tutorial starts by introducing the user to a character that takes the role of a guide and accompanies the user trough the rest of the application. The information is primarily conveyed to the user via audio, which has its spatial origin at the guide's character model. Prior to the guide's first instructions, the environment transforms, causing a variety of sounds all around the user. This encourages the user to look and even turn around. The guide only starts talking once the user has looked at the guides character model at least once. The guide now keeps talking no matter in which direction the user is facing. This can cause users to turn again, until they are again facing the right direction (the speaking guide), already introducing the first concept of movement in VR, showing the user that his real world movement translates 1:1 into the virtual environment. Additionally to the audio,

[1] https://www.valvesoftware.com/de/ [accessed: 18.12.2018]

the guide's instructions are displayed as subtitles beneath the guide.

Step 2: From this point forward the tutorial only advances to the next instruction when the task the user was asked to perform is completed. The guide now instructs the user to look around, drawing the user's attention to a border displayed 360 degrees around the user, achieving two things at once: Firstly, this repeats the before mentioned step of introducing movement and orientation to the user. This reinforces the lesson or introduces it, if the user did not turn in the previous steps. Secondly, it makes the user aware of the border as seen in Figure 3.1, which represents the available real world space within which the user can freely move around.

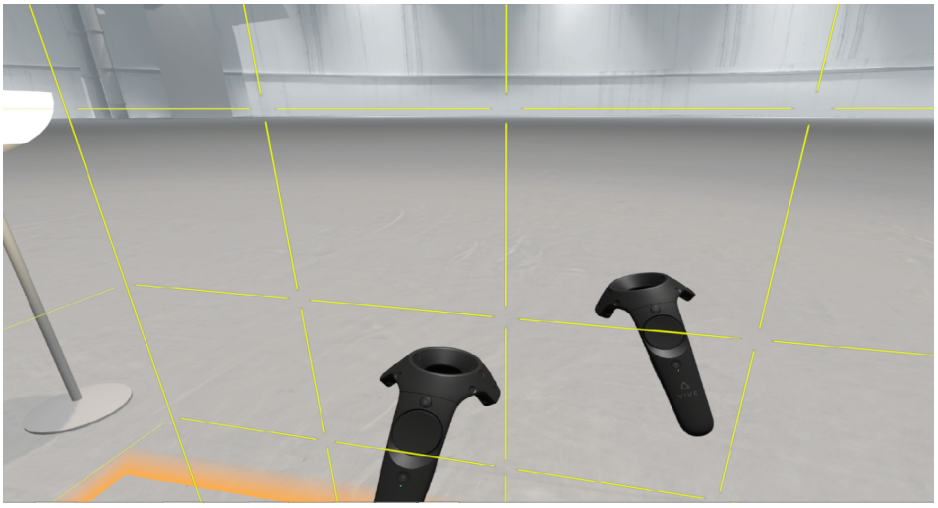

Figure 3.1.: Screenshot from SteamVR Tutorial - this screenshot shows the borders on the floor and the so called chaperon bounds which mark the area available to the users. While the mark on the floor are constantly visible, the chaperon bounds only appear when the user comes close the the edge of the predefined area.

At this point the tutorial also begins introducing terminology like the "play area" which refers to the area the user can move in, and "chaperon bounds" referring to a grid that becomes visible in case a user comes too close to the edges of the play area. These terms are basic terminology of the Vive system itself, meaning they are used across various applications running on the Vive system.

In order to make the chaperon bounds appear, the user is prompted to slowly walk towards the guide, consequently introducing the user to the possibility of actual physical movement.

Step 3: Since the beginning of the application the user has been holding two controllers, one in each hand. The controllers are visualized as accurate models of the physical controller, but up to this point none of the buttons nor movement had any effect. Now the guide mentions the controllers and asks the user to move them around. After the user does so, the next task is to press the buttons on the controller. Each button is referred to by name (e.g "trigger-button", "grip-button"), visually highlighted on the controller model, provided with a text label and its location on the controller is described by the guide, see Figure 3.2. Each button press results in feedback. There is the sound of a button being pressed, as well

as positive verbal reinforcement by the guide. Additionally, there is haptic feedback trough vibration of the controller and pressing the buttons results in visual animations, for example objects being shot out of the controller.

Representing the controllers as accurate models has an important effect: The tutorial is constantly referring to the controller, which is a real world object used to manipulate a virtual world. In terms of presence this could easily cause a BIP, drawing attention away from the state "V" and towards the fact that the user is only in a simulated environment, which is manipulated from the real world. But by accurately depicting the controllers in the virtual world, they become a part of this virtual environment and referring to them or assigning them functionality is no longer a direct reference to the real world. Therefore, any action by the controllers is no longer a "outside influence" from the real world, but rather an action from within the virtual environment. A further benefit of displaying accurate controller models is that the user's haptic and visual perception match. This not only facilitates the explanation of the button layout, but incorporates the sense of touch into the state "V". As Gallace et al. point out, getting the stimuli from multiple senses helps reinforcing the feel of presence and can even increase the enjoyment of a VR experience [GNSS12].

Figure 3.2.: Screenshot from SteamVR Tutorial - the currently explained buttons on the virtual controller models are being highlighted and labeled

After each button on the controller is explained, the tutorial ends and the application terminates.

3.1.2. Oculus First Contact

Oculus First Contact is a pure tutorial application similar to the SteamVR Tutorial, only exclusive to the Oculus system. It was designed to be[2] a general introduction to VR and the usage of the Oculus system, independent of specific applications. It consists of two mayor parts. The first part takes place in a empty room and introduces the basic controller functions. The second part consists of a short fictitious scenario, which reiterates on the controller functions and the interactive capabilities with the virtual surroundings. For a better understanding the following will separate the application into two parts and several

[2]https://www.oculus.com/experiences/rift/1217155751659625/ [accessed: 02.04.2019]

steps.

Part 1: Step 1: The application begins in an empty space, with only the tracked controllers visible. The controllers are represented by accurate models of the physical controller as well as silhouettes of hands on each controller. A voice then instructs the user to look around, pointing out the borders around the user, which represent the available physical space or "play area". In addition to the audio commands, the instructions are being displayed in a text box in front of the user. The instructing voice then directs the users attention towards the controllers, and encourages the users to move the controllers around as well as press the buttons on it. After a couple buttons were pressed, certain buttons are being highlighted and labeled and the user is instructed to press one button after another. The user is not only told which button to press but also with which finger the button should be pressed. Each time the user presses a button, the silhouette of the corresponding hand(s) and finger(s) also perform the button press on the virtual controllers. Certain actions are further paired with haptic feedback in the form of vibration.

Step 2: After the user completed the previous instructions, the tutorial removes the controller models, leaving only the silhouettes of the hands as representation. The instructor also stops referring to "controllers" but rather refers to "virtual hands". The user is again instructed to press any of the buttons. Each button press now prompts a finger to move on the virtual hand, allowing the user to perform hand gestures like clenching a fist or extending a finger. The user is given a few seconds to experiment, and then the instructor asks the user to perform specific gestures. The finger required to perform the gesture is highlighted and a text display names the gesture that is being performed.

Step 3: The final step of the first part asks the user to point at three spheres by performing a pointing gesture. As soon as the user performs the gesture a visual aid appears at the pointed finger and visualizes where the user is pointing. After pointing at all three spheres the introductory tutorial ends and teleports the user into a new scenario (part 2).

Part 2: In the second part of the Oculus First Contact application the user is spawned in a room filled with objects and a robot like character. After a short introductory sequence of the robot "coming to life", it starts handing the user discs. Small icons and highlighted areas suggest that these discs can be inserted in machines in front of the user. These machines in turn manifest various objects which each provide different interactive possibilities. One disc for example creates a gun and some targets for the user to shoot at, while another disc creates butterflies which land on the user's hand if a pointing gesture is performed. While the user can keep using the disks the robot provides, the user can also interact (grab, move and throw) with some objects in his proximity. At this point the user is given as little directions as possible, to freely explore the interactive possibilities.

3.1.3. SIMURAI

SIMURAI[3] is a cooperative first person shooter game developed by the company HOLOGATE. It runs on a location based system, developed for the business market, also named HOLOGATE. The current version of this system consists of five separate computers, one per player and one additional computer to control the camera. The computers are mounted on an overhead construction seen in Figure 3.3, that also holds a guide mechanism for the cables connecting the computers to the HTC Vive HMDs. HOLOGATE provides various applications for their VR System, one of which is SIMURAI.

SIMURAI is a local multiplayer game and can be played by up to four players. Each player gets one Vive controller fitted in a custom case that resembles a futuristic rifle. The players' goal is to defend a base against waves of robotic enemies while not getting shot themselves, thus earning points towards their scores.

Figure 3.3.: HOLOGATE Systems with 4 Players simultaneously playing.

As soon as a player puts on the HMD, the player sees a lobby room and a close virtual representation of the rifle he is holding. This initial room serves a double purpose. It acts as a lobby where players wait until all other players are logged in, and it also serves as a tutorial room. The tutorial lets the player experience the basic game controls. Being a location based system, the time the players spend in this room and the additional information provided by a guide depend on who runs the system. The entire system is controlled from an external control panel through which the actual game is started.

The lobby's environment resembles a big hall with bright orange targets folding out behind walls around the room, similar to a shooting range. Labels on the trigger as well as the grip buttons tell the user which button is used to shoot and which to reload. Part of the games mechanics are so called power ups, which grant the players special abilities for a short time period. The power ups are represented by colored symbols that float around the room. Once

[3]http://hologate.com/portfolio/simurai/ [accessed: 20.02.2019]

a player shoots at one of the symbols, a third label appears next to the Vive controllers' touch pad, telling the user that a press on the touch pad activates the power up. If the player turns around, other logged in players can be seen. The four players are arranged in a two by two grid with a small pedestal in the center, on top of which power ups can also spawn. Above the pedestal the words "shoot powerup" encourage the player to collect a power up if he has not already. Around each user's play area there are about waist high walls which are aligned with the outer bounds of the real world play area. These walls can be seen in Figure 3.4 and suggest that the players can not move beyond their respective play area. The walls function as a border which the user should not cross, essentially acting in the same way as the "chaperon bounds" mentioned in 3.1.1. To further discourage the players from moving beyond these walls, they later serve as cover from hostile projectiles during the gameplay.

Figure 3.4.: Ingame screenshot of the game SIMURAI. This is the a spectator camera angel showing four players in their respective sections defending their base.

After the game is started, a voice gives the players some context information as to where they are and that hostiles are approaching. From time to time the voice either reminds the players to use power ups or notifies them about the presence of a new type of enemy. Certain enemies have so called "weak points" where they can be hit for extra damage. These areas are indicated to the players by red animated marks on the enemies body. These marks also appear on certain types of enemy projectiles, signaling the players that those projectiles can be shot at and destroyed to avoid damage. Lastly, these marks appear on the shields of an entirely shielded enemy, which can only be damaged after its' shields have been destroyed.

3.1.4. Google Tilt Brush

Tilt Brush is an application developed by Google which allows the user to model or "paint" in three dimensional space. After the application launches the user can hear music and see the Tilt Brush logo being procedurally drawn. A fainted hint beneath the logo reads "Hold both triggers to skip", telling the user how to skip the intro if desired. As soon as the intro is finished the music stops and a hint appears next to one of the controllers, telling the user "Hold Trigger to Paint". The controller vibrates slightly to direct the users attention towards the controller. Additionally, sparkling stars float up from the controller to further

highlight it. The hint stays active until the controller's trigger is being pressed and held. To progress, the user has to hold down the trigger button and move the controller around slightly, which results in a blue line being drawn out of the tip of the controller. Every button press is now accompanied by a sound effect. As soon as the user releases the trigger for the first time after having drawn at least one line, the other controller gets highlighted by emanating sparkles and a slight vibration. A hint now appears reading "Swipe" next to the controllers touch pad. If the user swipes across the touch pad, a menu appears around the controller. The menu consists of three panels. One panel holds a color wheel to pick a color, the second panel contains a variety of tools or "brushes" the user can choose from to draw with and the last panel functions as a collection of settings like save, erase and undo. By swiping across the touch pad, the panels rotate around the controller and the user can switch between them. After activating the menu, a stream of little arrows emanates from the other controller's tip towards the menu. This is supposed to let the user know, that pointing the "non-menu" controller towards a menu panel is used to select menu items within a panel, as shown in Figure 3.5. Hovering over a menu item highlights it and the item's name appears. A hint now shows up next to the "non-menu" controller, telling the user to "Press Trigger to select". Once the user does select a menu item, the final hint appears, indicating that the tool's size can be adjusted by swiping the "non-menu" controllers touch pad.

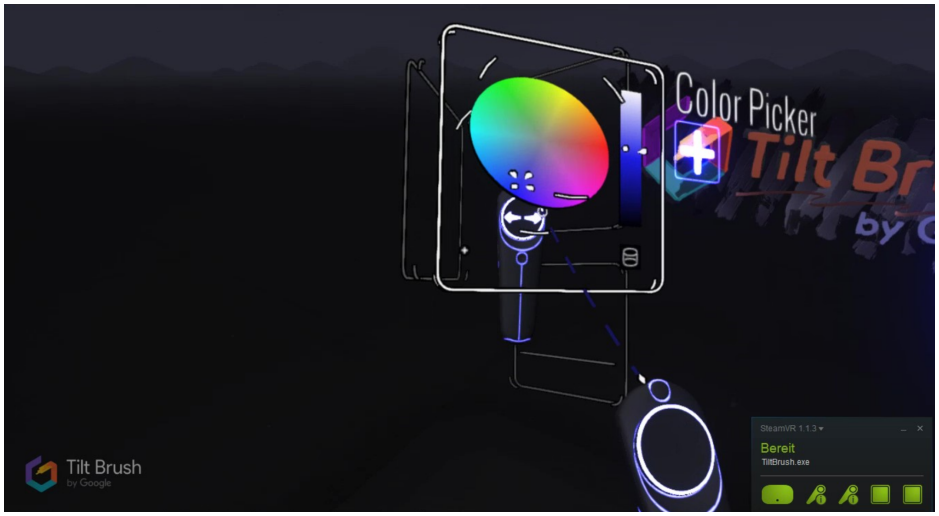

Figure 3.5.: Screenshot from Google Tilt Brush - one controller is used to select a color from the Color Picker. A line leaving the tip of the "non-menu" controller is used as an indicator showing what the user is currently pointing at.

The order of the functionalities introduced to the user is set so that the most basic action (drawing) is introduced first, followed by more advanced and non-essential functionalities like scaling the drawing tool. Between each hint the user is free to use the functions already shown to him by the tutorial as long as he wants. This has two effects. Firstly, this avoids interrupting a user. If a user for example follows the instructions and starts drawing, but then completely ignores the next hint and keeps drawing with the initially set brush color and size, the application does not force the user to change the brush settings or explore the menu. Secondly, experienced users can skip the tutorial without performing a specific

action. Somebody who knows how the application works completes the tutorial on the side simply by using the tools.

3.2. Evaluation Methodology

3.2.1. Questionnaire

To gain a better understanding of how users perceived tutorials in general and in VR, and to understand what they expected from a tutorial, a informal questionnaire (see appendix A.1) was given out to 26 people. Along the results of this questionnaire a checklist was constructed in order to better evaluate the different tutorials, beyond the four applications described in detail above. Some of the results will be provided in section 4.1.

The questionnaire consists of 3 sections and was given out in German. The answers to the respective last question of the first and second section determined whether the interviewees where shown the next section.

The first section asks about the participants general usage of tutorials and contained the following seven questions.

- If available, do you read / use instructions or tutorials?
- Which forms of instruction do you like best?
- Do you use instructions / tutorials several times? (e.g. do you like to look things up again or do you like to have things explained to you several times?)
- How exact do you think instructions or tutorials should be?
- What makes a good tutorial for you? (you can refer to a specific example)
- Are there certain requirements that a tutorial should always fulfill?
- Have you ever tried VR?

The second section, containing five questions asks which applications and systems the participants have used.

- How often have you tried VR applications or systems?
- How many different VR programs have you tried?
- Which VR applications have you already tried?
- In which environment did you predominantly use VR?
- Did you get / use a form of tutorial or manual during your VR experience?

The final three questions making up the last section focus on weather the questioned users have experience with tutorials in VR and if they have any suggestions of improving existing tutorials.

- Which form(s) of explanation / instruction did you get?
- Which aspects of the application were explained to you? (e.g. safety, control, etc.)
- Would you have liked additional explanation / guidance? If so, for what and in which form?

3.2.2. Checklist

The checklist derived from the analysis of various VR applications and the results of the questionnaire, consists of 21 items spread across 6 main categories.

Safety

- pre-existing conditions – does the application mention if there are pre-existing conditions that might effect the user while experiencing the application, and if so is the user told so or warned.
- anxiety – is there any mention on the fact, that depending on the contents and environments of the application, users can experience anxiety during VR usage.
- motion sickness – same as anxiety, some users can experience motion sickness during VR applications. Motion sickness can occur "when physically stationary individuals view compelling visual representations of self-motion. It may also occur when detectable lags are present between head movements and recomputation and presentation of the visual display in helmet-mounted displays." as noted by Hettinger and Riccio [HR92].
- recommended playtime – describes whether an application has a recommended playtime and if so if this is enforced by the application or mentioned to the user.

General Limitations (application / system)

- seated / standing – does the application address whether the the application is to be experienced seated or standing.
- movement / stationary – does the application address the topic of movement. If there are certain forms of movements required or prohibited, is the user informed about this fact.
- special requirements (e.g extra room needed) – does the application address any requirements for extra space (e.g. more than the default configuration of the system itself), or a predefined area. Are peripheral objects like boxes or planks part of the application and does the user have to be aware of this.

Controls

- controlling medium (controllers, movement) – is the user given any explanation of the medium used to control the application.

- functionality (effect of controls) – describes if the user is given information about the functionalities triggered by the controlling medium. For example, does the user know the full extend of what a certain button press leads to.
- body(movement) as controller – since the possibilities of motion control and tracking are two of the key features of VR, this point checks if the application informs the user about tracking and the usage of the user's body as a means of controlling the application.

Goals

- motivation behind application – is there a goal to achieve, and if so is it mentioned to the user.

Pacing

- only one tutorial with all the information – is the majority of information given to the user at once, or spaced out across the duration of the application.
- controls limited to each explained step – this point describes if an application for example disables all the controls except for the currently addressed one, or subsequently unlocks control features after they have been explained to the user.
- repeatable tutorial – can the tutorial be repeated if the user wishes to do so.
- tutorial part of bigger context (e.g. game story) – especially considering VR games. Are the tutorial and explanations separated from the rest of the application or for example, is the user given information as part of the games story.

Form

This section notes, whether an application presents instructions in one or multiple of the forms, listed below.

- images
- videos
- text
- audio
- interactive
- external assistance

Each application was checked as either fulfilling a criterion fully, in parts or not at all (yes, in parts, no), depending on whether the applications mentioned the respective aspects. The section 4.2.1 will further clarify why an application, if that is the case, was categorized as fulfilling a criterion of the checklist "in parts".

4. Results

This chapter will outline the questionnaire given out during the user study and present its' results. For the full questionnaire see appendix A.1. Section 4.2 will provide the checklist created in order to evaluate current approaches to user guidance in VR, in addition to the analysis results of eleven applications evaluated by the said checklist.

4.1. Questionnaire

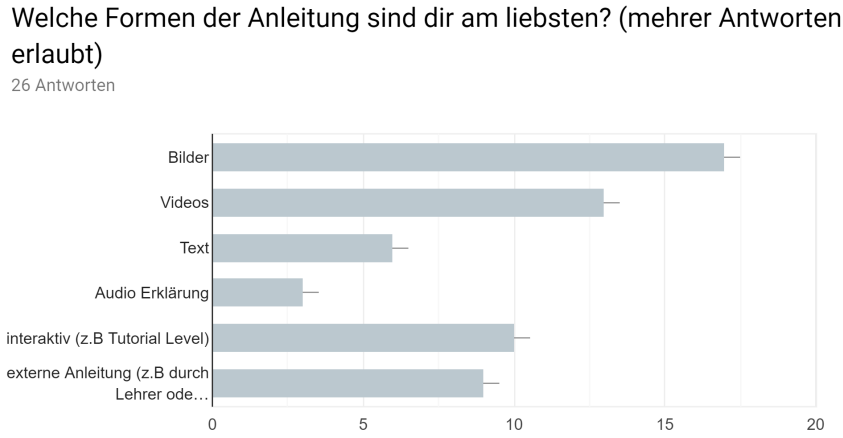

Figure 4.1.: Question 2: What form of instructions do you prefer?(multiple allowed)

In the first section of the questionnaire, which asked about the participants' preferences regarding tutorials and manuals in general, more than half stated that they prefer visual aid, such as videos or images, and interactive explanations, as shown in 4.1. Merely 23,1% prefer text and only 11,5% audio as preferred form of instruction. When further asked about which aspects a tutorial should always contain and what they expected from good tutorials, multiple participants listed features like brevity and the focus on essential and basic aspects of the explained subject. Several answers also mentioned comprehensibility as a necessity for every tutorial. Those answers listed factors like language localization and avoidance of technical terms as ways of achieving that.

In the second and third section, the participants were asked about their experience with VR applications and user guidance when experiencing VR.

Just under half of the interviewees stated that they had occasionally used VR before and 32% had used VR for the first time at the time of completing the questionnaire. 68% of the

people asked stated, that they had experienced five or less VR applications. When asked about the nature of the experienced applications, the majority were gaming applications, including Richies Plank Experience, Simurai or Beat Saber. Further 76% reported to have predominantly used VR in event locations or VR centers, which coincides with the list of experienced applications and the fact that the questionnaire was for the most part given out to customers of the PRESENCE Virtual Reality Center in Munich, Germany.

As Figure 4.2 shows, out of 19 people, 89,5% were given some form of external instruction in addition to other means of user guidance like audio, visual or interactive tutorials.

Virtually all noted that they had received instruction about the means of controlling the respective application. Some received additional instructions regarding safety. None of the asked indicated that they wished for or needed further explanations. Two participants added to their answers, that in their opinion, the simplicity of the majority of applications available up to this point allow most users to deduce controls and other aspect of the applications without much explanation.

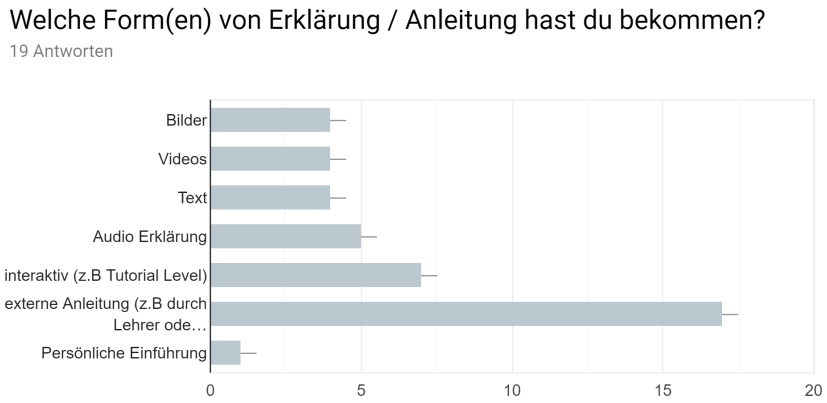

Figure 4.2.: Question 13: What forms of instructions were given to you, while experiencing VR?

4.2. Checklist

Following is the checklist, analyzing 11 applications and their implemented user guidance.

Application:	Steam VR Tutorial			Oculus First Contact			SIMURAI		
	yes	in parts*	no	yes	in parts*	no	yes	in parts*	no
safety									
pre-existing conditions			x			x			x
anxiety			x			x			x
motion sickness			x			x			x
playtime			x			x		x	
general limitations (application / system)									
seated / standing	x					x	x		
movement / stationary	x					x			x
special requirements	x					x			x
controls									
controlling medium	x			x			x		
functionality	x			x			x		
navigation / movement									
body as controller	x			x					x
goals									
motivation	x					x			x
pacing									
singular tutorial	x			x					x
controls limited	x			x					x
repeatable tutorial	x			x					x
bigger context	x			x					x
form									
images			x	x					x
videos			x			x			x
text	x					x	x		
audio	x					x			x
interactive	x			x			x		
external assistance			x			x	x		

* further explination can be found in section 4

Application:	Portal Stories VR			Google Blocks			Beat Saber		
	yes	in parts*	no	yes	in parts*	no	yes	in parts*	no
safety									
pre-existing conditions			x			x			x
anxiety			x			x			x
motion sickness			x			x			x
playtime			x			x			x
general limitations (application / system)									
seated / standing	x					x	x		
movement / stationary	x					x	x		
special requirements			x			x			x
controls									
controlling medium	x			x			x		
functionality	x			x			x		
navigation / movement									
body as controller			x			x	x		
goals									
motivation	x					x			x
pacing									
singular tutorial			x	x			x		
controls limited			x	x					x
repeatable tutorial			x	x			x		
bigger context	x					x			x
form									
images	x			x			x		
videos	x					x			x
text	x			x			x		
audio	x					x			x
interactive	x			x					x
external assistance			x			x			x

* further explination can be found in section 4

Application:	Google Tilt Brush			Space Pirate Trainer			Google Earth VR		
	yes	in parts*	no	yes	in parts*	no	yes	in parts*	no
safety									
pre-existing conditions			x			x			x
anxiety			x			x			x
motion sickness			x			x			x
playtime			x			x			x
general limitations (application / system)									
seated / standing			x			x			x
movement / stationary			x	x					x
special requirements			x			x			x
controls									
controlling medium	x			x			x		
functionality	x			x			x		
navigation / movement									
body as controller			x	x					x
goals									
motivation			x			x			x
pacing									
singular tutorial	x			x			x		
controls limited		x				x			x
repeatable tutorial			x			x	x		
bigger context	x					x			x
form									
images			x	x			x		
videos			x			x			x
text	x			x			x		
audio			x			x			x
interactive	x					x	x		
external assistance			x			x			x

* further explination can be found in section 4

Application:	Richie's Plank Experience			Eagle Flight		
	yes	in parts	no	yes	in parts*	no
safety						
pre-existing conditions	x			x		
anxiety			x			x
motion sickness			x			x
playtime			x			x
general limitations (application / system)						
seated / standing			x			x
movement / stationary			x			x
special requirements	x					x
controls						
controlling medium			x			x
functionality	x					x
navigation / movement						
body as controller			x	x		
goals						
motivation			x	x		
pacing						
singular tutorial	x					x
controls limited			x	x		
repeatable tutorial			x	x		
bigger context			x	x		
form						
images	x			x		
videos			x	x		
text	x			x		
audio			x			x
interactive			x	x		
external assistance			x			x

* further explination can be found in section 4

4.2.1. Clarification

This section explains why an application was marked as fullfilling a category "in parts" on the checklist, if that is the case.

SIMURAI - playtime: while the game does not explicitly state a recommended playtime, due to the application being part of a commercial attraction, each round lasts exactly ten minutes, therefore limiting the playtime in a way.

Google Tilt Brush - limited controls: only certain functionalities are active at the start of the application for the purpose of explaining the basic functionalities step by step to the user. However, the sequence is chosen in such a way that an experienced user can forego the tutorial by simply starting to draw (see subsection 3.1.4).

4.2.2. Checklist Results

One of the first things to note, is that virtually none of the chosen applications provide information or warnings about any safety risks or health hazards, even though VR is known to potentially cause discomfort, nausea or motion sickness in certain users.

With the exception of a few applications like Space Pirate Trainer, most applications do not address or recommend whether the application is best experienced seated, or standing. While many applications can be experienced both ways, there usually is an intended way and many applications seem to rely on the user to notice which positioning is intended without any hints or clarification from the application. It has to be noted, that at least in the case of the Vive system, and therefore all tested applications except for Oculus First Contact, the available space and tracked area as well as whether the system is set up for seated or standing use is defined and setup by the Vive Software independent of the application. This could be the reason why many applications do not address these points at all. In case the systems has to be set up in a certain way for an application to run properly, the user is usually notified at application launch.

All applications seem to address basic controls and functionalities in some form or another. But even though all tested applications allowed for the user to move around in actual space, utilizing the users body movement as a form of navigating the application, merely half stated this. With tracking and the subsequent possibility of movement being such a key feature of VR, it almost seems that many applications expect users to know about the possibilities of moving around and utilizing their body as a form of controller.

Almost none of the applications give the user any motivation for completing the tutorials or application itself, and rarely is the tutorial part of a bigger context like a story. While this may be by choice for some applications, most applications do not seem to provide a story or context in the first place. This might be due to the "demonstration" like character of many current applications, which are not nearly as extensive or sophisticated as comparable software available for other mediums. Probably for similar reasons, many developers seem to prefer exposing the user to one single tutorial containing all information. At least in the case of shorter applications this seems reasonable, since there is not enough depth to the

application to warrant multiple tutorial sections.

While the majority of applications provided some sort of interactive tutorial, all applications with the exception of Oculus First Contact used text to convey information. One possible explanation for this could be that it is probably one of the easiest forms to implement and in contrast to for example audio works regardless of connected speakers or headphones. Also in many cases text is used as an addition and to repeat information that is also being conveyed via other channels. One example being subtitles showing the text of an audio tutorial in the case of Steam VR Tutorial.

4.3. Discussion

4.3.1. Evolution of the VR market

It seems likely that while most users seem content with the current implementations and the scope of tutorials, a growing market of VR systems and applications will sooner or later produce more complex and extensive applications. Further, with VR systems becoming more accessible and affordable to the consumer market, the frequency of VR usage in public and commercial environments where external assistance is often provided, could decrease and develop more towards home usage, which requires different forms of user guidance. Similar developments can be observed with other mediums like game consoles or computers. And without the development of universal peripherals and control schemes in the near future, this will probably further the demand for comprehensive tutorials tailored to VR applications and their respective systems.

4.3.2. Selected applications

The selection of applications considered in this thesis was partially influenced by their availability and cost. While the list of applications consists of free and paid applications, all applications are developed for the consumer market. Therefore, this thesis does not review industrial grade applications, like those used by the military[1] or private companies. Techniques and methods used in such applications might vary from the ones listed in this thesis. With the exception of "Oculus First Contact", all applications were reviewed on the HTC Vive system and acquired via the Steam Store, since the PRESENCE Virtual Reality Center exclusively uses the Vive System and all tests were conducted there.

4.3.3. Study environment

As mentioned in section 4.1 a majority of the users questioned completed the questionnaire at the PRESENCE Virtual Reality Center and stated that they had gathered the majority of their experiences with VR at VR centers or similar locations. It has to be noted, that at PRESENCE and similar locations, each user is at least initially accompanied by an employee that provides explanations and individual assistance. Therefore, users might experience additional user guidance compared to other users experiencing the same applications

[1] https://thinkmobiles.com/blog/virtual-reality-military/ [accessed: 15.05.2019]

in a different environment.

4.3.4. Schedule of guidance

One aspects of user guidance that has not been considered in this thesis is the point in time of providing user guidance. Different types of user guidance like external assistance or manuals for example allow the user to receive instructions before starting or even entering a VR application or system. Meanwhile, tutorial levels, text hints and similar methods can provide guidance during an application. This aspect of timing is also connected to whether tutorials are mandatory and if they are available on demand to the user.

5. Conclusion & Future Work

This thesis provides a brief overview of some current approaches to user guidance in VR and the potential challenges developers can face implementing said approaches. The topic of user guidance in VR is a relatively untouched area of research, and currently, as also stated by some participants of the conducted questionnaire, many applications may allow for users to deduce the majority of functions on their own. But with the evolution of hardware and software in the field of VR, applications are becoming more complex, thus tutorials and user guidance will be necessary at some point.

In order to develop a way of evaluating current approaches to user guidance in VR, a user study with 26 participants was conducted as part of this thesis. On the bases of the results and a detailed analysis of 3 applications, a checklist was created. The checklist was used to analyze a selection of 11 applications. Its' results showed that many areas, including health and safety risks as well as basic concepts of movement are relatively unaddressed by a lot of applications. Also, the variety of approaches to user guidance seems to hint at the fact, that there is no best practice yet. Further research including user studies focused specifically on elements of user guidance in VR will be needed to better evaluate the various forms of user guidance available. Additionally, the analysis of a broader spectrum of applications, including those used in professional fields such as healthcare or the military could yield further insight into the approaches and effects of user guidance. Such research will also have to show whether existing approaches of implementing user guidance are sufficient, or if new approaches have to be found to optimally convey information.

A. Appendix

A.1. Questionnaire

Befragung zum Thema Anleitungen / Tutorials

Im Rahmen einer Studienarbeit beschäftige ich mich mit dem Thema Benutzerführung, genauer gesagt, Tutorials für Anwendungen und Systeme in der Virtuellen Realität. In dieser kleinen Umfrage (ca 2-3 Minuten) möchte ich ein paar Dinge von dir bezüglich deiner generellen Nutzung und Erwartung an Tutorials erfragen.

Der erste Teil dieser Befragung ist nicht exklusiv auf Virtuelle Realität(VR) bezogen, deshalb kannst du mir auch weiterhelfen wenn du VR noch nie ausprobiert hast. Deine Antworten sollen mir dabei helfen ein Gefühl für deine Erfahrungen mit verschiedenen Formen von Benutzerführung zu bekommen. Deshalb kannst du jede Frage auf jede beliebige Form von Benutzerführung beziehen (z.B. Videospiel Tutorials, Wikis, Youtube How-To Videos oder IKEA Anleitungen).

Danke,
Joan

* Erforderlich

1. **Wenn vorhanden, liest / nutzt du Anleitungen oder Tutorials?**
   Markieren Sie nur ein Oval.

   - ◯ Ja
   - ◯ eher Ja
   - ◯ eher Nein
   - ◯ Nein

2. **Welche Formen der Anleitung sind dir am liebsten? (mehrer Antworten erlaubt)**
   Wählen Sie alle zutreffenden Antworten aus.

   - ☐ Bilder
   - ☐ Videos
   - ☐ Text
   - ☐ Audio Erklärung
   - ☐ interaktiv (z.B Tutorial Level)
   - ☐ externe Anleitung (z.B durch Lehrer oder Einweiser)
   - ☐ Sonstiges: _____

3. **Nutzt du Anleitungen / Tutorials mehrmals? (z.B schlägst du gerne Dinge noch ein mal nach oder lässt dir Dinge gern mehrmals erklären?)**
   Markieren Sie nur ein Oval.

   - ◯ Ja
   - ◯ eher Ja
   - ◯ eher Nein
   - ◯ Nein

4. **Wie genau sollten Anleitungen oder Tutorials deiner Meinung nach sein?**
   Markieren Sie nur ein Oval.

	1	2	3	4	5	
nur die nötigsten Informationen	◯	◯	◯	◯	◯	sehr detailliert

5. **Was macht eine gute Anleitung oder Tutorial für dich aus? (beziehe dich gerne auf ein spezifisches Beispiel)**

6. **Gibt es bestimmte Anforderungen die eine Anleitung oder ein Tutorial für dich immer erfüllen sollte?**

7. **Hast du schon einmal VR ausprobiert?** *
   Markieren Sie nur ein Oval.

   ◯ Ja *Weiter mit Frage 8*
   ◯ Nein *Ausfüllen dieses Formulars beenden*

VR Nutzung

Alle nachfolgenden Fragen beziehen sich spezifisch auf Virtuelle Realität.

8. **Wie oft hast du schon VR Anwendungen oder Systeme ausprobiert?** *
   Markieren Sie nur ein Oval.

   ◯ ein Mal
   ◯ ein paar Mal
   ◯ häufig
   ◯ regelmäßig

9. **Wie viele verschiedene VR Programme hast du schon ausprobiert?** *
   Markieren Sie nur ein Oval.

   ◯ unter 5
   ◯ 5-10
   ◯ mehr als 10

10. **Welche VR Programme hast du schon ausprobiert?**

_____

_____

_____

_____

_____

11. **In welchem Umfeld hast du VR überwiegend genutzt?** *
Markieren Sie nur ein Oval.

- ◯ privat
- ◯ im Rahmen eines Forschungsprojektes (z.B Nutzerstudie)
- ◯ Event Location, VR Center
- ◯ Sonstiges: _____

12. **Hast du während deiner VR Erfahrung ein Form von Tutorial oder Anleitung bekommen / genutzt?** *
Markieren Sie nur ein Oval.

- ◯ Ja *Weiter mit Frage 13*
- ◯ Nein *Ausfüllen dieses Formulars beenden*

Deine Erfahrungen mit Tutorials in VR

13. **Welche Form(en) von Erklärung / Anleitung hast du bekommen?**
Wählen Sie alle zutreffenden Antworten aus.

- ☐ Bilder
- ☐ Videos
- ☐ Text
- ☐ Audio Erklärung
- ☐ interaktiv (z.B Tutorial Level)
- ☐ externe Anleitung (z.B durch Lehrer oder Einweiser)
- ☐ Sonstiges: _____

14. **Welche Aspekte der Anwendung wurden dir erklärt? (z.B Sicherheit, Steuerung, etc.)**

_____

_____

_____

_____

_____

15. **Hättest du dir mehr Erklärung / Anleitung gewünscht? Wenn ja, zu was und in welcher Form?**

List of Figures

Bibliography

[BB93] Bricken, Meredith ; Byrne, Chris M.: Chapter 9 - Summer Students in Virtual Reality: A Pilot Study on Educational Applications of Virtual Reality Technology. Version: 1993. http://dx.doi.org/https://doi.org/10.1016/B978-0-12-745045-2.50019-2. In: WEXELBLAT, ALAN (Hrsg.): *Virtual Reality*. Academic Press, 1993. – DOI https://doi.org/10.1016/B978–0–12–745045–2.50019–2. – ISBN 978–0–12–745045–2, 199 - 217

[GNSS12] Gallace, Alberto ; Ngo, Mary K. ; Sulaitis, John ; Spence, Charles: Multisensory Presence in Virtual Reality. Version: 2012. http://dx.doi.org/10.4018/978-1-60960-821-7.ch001. In: *Multiple Sensorial Media Advances and Applications*. IGI Global, 2012. – DOI 10.4018/978–1–60960–821–7.ch001, S. 1–38

[HR92] Hettinger, Lawrence J. ; Riccio, Gary E.: Visually Induced Motion Sickness in Virtual Environments. In: *Presence: Teleoperators and Virtual Environments* 1 (1992), jan, Nr. 3, S. 306–310. http://dx.doi.org/10.1162/pres.1992.1.3.306. – DOI 10.1162/pres.1992.1.3.306

[IGa17] IGate: Global Virtual Reality Market (Hardware and Software) and Forecast to 2020. (2017). http://www.orbisresearch.com/reports/index/global-virtual-reality-market-hardware-and-software-and-forecast-to-2020

[MS00] Mel Slater, Anthony S.: A Virtual Presence Counter. In: *Presence Teleoperators & Virtual Environments* (2000). http://dx.doi.org/10.1162/105474600566925. – DOI 10.1162/105474600566925

[Sla03] Slater, Mel: A note on presence terminology. In: *Presence connect* 3 (2003), Nr. 3, 1–5. http://citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.800.3452&rep=rep1&type=pdf

[Ste93] Steuer, Jonathan: Defining Virtual Reality: Dimensions Determining Telepresence. In: *Journal of Communication, 42(4) (Autumn, 1992)* (1993), S. 73–93. http://dx.doi.org/10.1111/j.1460-2466.1992.tb00812.x. – DOI 10.1111/j.1460–2466.1992.tb00812.x

[Whi14] White, Matthew M.: *Learn to Play: Designing Tutorials for Video Games*. CRC Press, 2014. http://dx.doi.org/10.1201/b17044. http://dx.doi.org/10.1201/b17044