

Flexible Learning Settings in Second Life

Master Thesis

at

Graz University of Technology

submitted by

Stefan Freudenthaler

stefan@freudenthaler.net

supervised by

Univ.-Doz. DI Dr.techn. Christian Gütl
IICM, Graz University of Technology, Austria

Dr. Vanessa Chang
CBS, Curtin University Perth, Australia

Graz University of Technology
Institute for Information Systems and Computer Media
A-8010 Graz, Austria



Graz, January 20, 2011

Flexible Lernumgebungen in Second Life

Diplomarbeit

an der
Technische Universität Graz

verfasst von
Stefan Freudenthaler
stefan@freudenthaler.net

betreut von

Univ.-Doz. DI Dr.techn. Christian Gütl
IICM, Technische Universität Graz, Österreich

Dr. Vanessa Chang
CBS, Curtin University Perth, Australia

Technische Universität Graz
Institut für Informationssysteme und Neue Medien
A-8010 Graz, Österreich



Graz, 20. Januar 2011

Abstract

Today a lot of effort is being invested in educational institutions to improve their services and adapt to the rapidly changing society. One opportunity to enable that is the usage of immersive virtual environments. These environments provide new possibilities to work collaboratively without being geographically dependent and offer opportunities to attend class all over the world. There exist a number of learning settings, in Virtual Worlds, which are designed for learning styles that do not support flexible environments. Such a situation has motivated this research with the aim to develop a prototype that supports configuration and adaptation of virtual learning environments according to the learners' and educational needs.

The theoretical section of this thesis investigates the development Virtual 3D Worlds, Learning Management Systems (LMS) and how it is possible to improve some of the disadvantages of LMS through the use of Virtual 3D Worlds. In particular, the history, important attributes, educational usage and current important Virtual 3D Worlds are discussed. By juxtaposition, this section discusses the design, architecture, history and problems of Learning Management Systems. The practical section of this thesis is based on the findings of the theoretical section. Inter alia, these results influenced the requirements for this project. The findings have been implemented into a prototype application that provides learning environments in a highly flexible and adaptable way. In addition, the tool creates specific learning settings on-demand - as such, a user can prepare a preferred learning situation outside the Virtual World without any particular knowledge of in-world programming or scripting. Furthermore, the prototype application can limit access to the learning environment and assign it to time slots so, that learning settings are actualized on-demand. The prototype is based on Second Life.

At the end of this thesis, preliminary findings within this prototype, in combination with Second Life, are discussed and a short case study is presented which shows the basic functions of the application have been realized.

Kurzfassung

In der heutigen Zeit investieren Bildungseinrichtungen sehr viel Energie um ihr Angebot zu verbessern und sich an die schnell verändernde Gesellschaft anzupassen. Eine Möglichkeit diese zu tun, ist die Verwendung von immersiven virtuellen Welten. Diese bieten neue Möglichkeiten des gemeinsamen Arbeitens, ohne geografisch am gleichen Ort, wie zum Beispiel der Klassenraum, zu sein. Die derzeitigen Lernumgebungen in virtuellen Welten bieten leider wenige flexible Ansätze für verschiedene Lernsituationen. Dieser Umstand dient als Motivation um einen Software Prototypen zu entwickeln, welcher es ermöglicht die Konfiguration und Anpassungsfähigkeit von virtuellen Lernumgebungen in einem flexiblen Ansatz zu realisieren.

Der theoretische Teil dieser Arbeit konzentriert sich auf die Entwicklung und aktuelle Situation von virtuellen 3D Welten, Learning Management Systemen und wie es möglich ist Nachteile von LMS mittels virtuellen 3D Welten zu verbessern. Insbesondere werden der geschichtliche Hintergrund, wichtige Eigenschaften von 3D Welten, Nutzung durch Bildungseinrichtungen und die derzeit populärsten virtuellen 3D Welten behandelt. In einer ähnlichen Weise wird auch auf das Design, Architektur, Geschichte und Probleme von LMS eingegangen.

Basierend auf den Erkenntnissen der Theorie dieser Arbeit definiert der praktische Teil die Anforderungen an eine Software, welche es ermöglicht Lernumgebungen komplett flexible, anpassungsfähig und nur bei Bedarf zu erzeugen. Ein Benutzer kann von ihm bevorzugte Lernsituation außerhalb der virtuellen Welt vorbereiten, ohne spezielle Kenntnisse im Bezug auf die virtuelle Welt oder Programmieren zu haben. Diese Lernsituation wird dann automatisch in der virtuellen Welt umgesetzt. Darüber hinaus, kann der Zutritt von anderen Benutzern eingeschränkt und die Umsetzung auf ein bestimmtes Zeitfenster fixiert werden. Dieser Prototyp wurde für die virtuelle Welt ‚Second Life‘ realisiert.

Am Ende dieser Arbeit, werden gewonnen Erkenntnisse, im Bezug auf den Prototyp und der Kombination mit Second Life, aufgezeigt und die Ergebnisse einer kleinen Fallstudie zeigen, dass die grundlegenden Funktionen der Anwendung realisiert wurden.

Statutory Declaration

I declare that I have authored this thesis independently, that I have not used other than the declared sources / resources, and that I have explicitly marked all material which has been quoted either literally or by content from the used sources.

Graz, January 20, 2011

signature

Notes of Thanks

I want to thank the most important people in my life, my family and my friends. They accompanied me throughout the years at university and this Master Thesis in an almost perfect way, helped me in difficult times and supported me at my studies in Australia.

Concerning this work, I want to thank my supervisor Univ.-Doz. Dipl.-Ing. Dr.techn. Christian Gütl, who supported me with ideas and always lent a ready ear to my problems. I also owe him that I got the chance to complete parts of this paper at Curtin, University of Technology in Western Australia. In this time, my second supervisor, Dr. Vanessa Chang and her team, especially Muriel Bijoux helped us in a warm and caring way. They welcomed me cordially, and I had the chance to be part of an international research community.

Furthermore, I want to thank several institutions for supporting me with scholarships. Studying abroad is always an additional financial burden and they helped me enormously.

My time at university had several ups and downs. Especially in the 'downs' my family and my close friends supported me throughout these hard times.

Thank you very much!

Contents

1	Introduction	1
1.1	Background and Motivation	2
1.2	Structure	3
2	Virtual 3D Worlds	5
2.1	Definition	5
2.2	History	6
2.3	Typology of Virtual Worlds	8
2.4	Attributes of Virtual Communities	9
2.5	Educational usage of Virtual Worlds	10
2.6	Currently Important Virtual Worlds	11
2.6.1	Sign ups	11
2.6.2	Average Concurrent Player	13
2.7	Second Life	14
2.7.1	Features	14
2.7.2	Technology	15
2.7.3	System Requirements	16
2.8	World of Warcraft	17
2.8.1	Features	17
2.8.2	Technology	18
2.8.3	System Requirements	19
2.9	Open Wonderland	19
2.9.1	Features	20
2.9.2	Technology	21
2.9.3	System Requirements	21
2.10	Open Simulator	22
2.10.1	Features	22
2.10.2	Technology	24
2.10.3	System Requirements	25
2.11	There	26

2.11.1	Features	27
2.12	Discussion	28
3	Learning Management Systems	29
3.1	Definition	29
3.2	Architecture	31
3.3	History	32
3.4	Different Types of LMS	34
3.4.1	Traditional, Classic LMS	34
3.4.2	Other Types of LMS	35
3.5	Problems of LMS	35
3.5.1	Social Drawbacks	36
3.5.2	Security Drawbacks	37
3.6	Discussion	38
4	Learning Environments in Virtual Worlds	39
4.1	Sloodle	39
4.1.1	Moodle	39
4.1.2	Features	40
4.1.3	Technology	41
4.1.4	Educational Value	42
4.2	Virtual Presence of TU Graz in Second Life	44
4.2.1	Features	44
4.3	SciLands	45
4.4	Discussion	48
5	Project 'Second Life Room Manager'	49
5.1	Design	50
5.1.1	Project Idea	50
5.1.2	Online Survey	50
5.1.3	Requirements	53
5.1.4	Second Life in Detail	55
5.2	Development	61
5.2.1	Partition Web - SL	61
5.2.2	Used Software	63
5.2.3	Off-world	64
5.2.4	SL Realization	70
5.3	Usage	76
5.4	Findings	81
5.4.1	Developers Point of View	81

<i>CONTENTS</i>	iii
5.4.2 Users Point of View	84
5.4.3 Case Study	85
5.5 Discussion	87
6 Lessons Learned	89
7 Summary and Outlook	91
Bibliography	93
A Online Survey	97
B Survey answers	105
C Post Survey	115
D CD-ROM	119

List of Figures

2.1	Sensorama to simulate odors	7
2.2	Topology of virtual communities	9
2.3	Growth of different Virtual Worlds	12
2.4	Second Life Sign Ups	13
2.5	Concurrent Users in Second Life	14
2.6	World of Warcraft statistic	15
2.7	Screenshot of World of Warcraft	18
2.8	Screenshot of Open Wonderland	20
2.9	Screenshot of OpenSimulator	23
2.10	OpenSimulator in Standalone Mode	24
2.11	OpenSimulator Grid Sample	24
2.12	Screenshot of There	26
3.1	Ideal typical architecture of a Learning Management System	31
3.2	Example screen from WebCT, showing Linear Structure	35
4.1	Architecture of Sloodle	42
4.2	Welcome Cube at TU Graz Island	44
4.3	Menu to select furniture	45
4.4	Automatically created classroom	45
4.5	Second Life SciLands Map	46
5.1	Collaborative Learning Setting	51
5.2	Second Life User Interface	55
5.3	Second Life Interface Top Bar	56
5.4	Second Life Interface Bottom Bar	56
5.5	Second Life Interface Side Bar	57
5.6	Different primitive shape types	58
5.7	E-Mail communication	60
5.8	XML-RPC communication	60

5.9	HTTP-Request communication	60
5.10	Conceptual Architecture	62
5.11	Graphical User Interface	64
5.12	Feature time slots	66
5.13	Feature access control	66
5.14	Response of the Background Interface after a request	68
5.15	Database schema	68
5.16	SL Realization of 5.11	70
5.17	SL-Brain during receiving data in Second Life	71
5.18	SL-Brain procedure	71
5.19	Sample sequence	74
5.20	Multiple Areas	77
5.21	Big Scenario prepared to send to SL	77
5.22	Assigning time slots to scenarios	78
5.23	Controlling access to scenarios	78
5.24	SL-Brain during receiving data and creating items	79
5.25	SL-Brain during receiving data and creating items	79
5.26	SL-Brain during receiving 'MOVE' commands	79
5.27	SL-Brain during creating the wall	79
5.28	SL-Brain finished	80
5.29	Controlling access to scenarios	80

List of Tables

2.1	Virtual 3D Worlds Ranking	8
2.2	Second Life System Requirements for Windows	16
2.3	Land use fees in Second Life	16
2.4	WoW System Requirements for Windows	19
2.5	System Requirements of Open Wonderland	21
2.6	Compatible Viewers for Open Sim	22
2.7	OpenSimulator Features	23
2.8	System Requirements of OpenSim	25
4.1	SciLands Examples	47
5.1	Result of the Online Survey	52
5.2	Requirements off-world	54
5.3	Requirements in-world	55
5.4	Communication methods in Second Life	59

Chapter 1

Introduction

Nowadays, in the changing society, everybody has to adapt their skills according to political, social, economical, technological and environmental diversifications. Correspondingly, education with their learning goals and processes as well as learning environments have to support these changes. From less formal schooling to 'mechanized' knowledge transfer in the industrialization age, education has changed. As well as learning groups of students and tutors become more and more dynamic in terms of their needs and the tendency to be more dispersed in a geographical way. (Gütl & Chang, 2008) Similarly Shrivastava (1998) wrote:

"Traditional teaching/learning approaches of highly structured and polished lessons in pre-programmed classes are too static for the digital economy environment."

One opportunity for digital learning is the usage of Virtual 3D Worlds. Already a large number of learning applications in virtual environments have been designed. (Freitas, 2008)

This document focuses on motivation and development of a web based tool which improves learning in a particular Virtual World, Second Life. It enhances virtual learning with being completely flexible in creating learning settings and transposing them on-demand.

1.1 Background and Motivation

Today, a lot of effort is being invested at educational institutions, especially universities, to improve their proposal to this changing requirements. Systems got developed to attract students who are unable or unmotivated to come to class personally. Like immersive virtual environments provide new possibilities to work collaboratively without being geographically dependent and offer opportunities and flexibilities to attend classes all over the world. But not every student's reason for distance learning is geographical based, most of them just want to be more flexible. (Bates, 2005) Learning environments, like a 'Learning Management System', which offers learning contents in an easy way, can help in such situations. Unfortunately, this kind of systems have drawbacks, like 'Lack of interactivity' or 'Miscommunication by Text Only'. Virtual 3D worlds, like Second Life, Project Wonderland or Open Simulator, can improve such situations by taking advantage of the multiple communication channels and the social engagement associated with presence and awareness.

According to Freitas (2008), there exists a wide range of different virtual world applications which were designed for training and learning in various subject domains including activities such as virtual lectures and seminars, pre-work training scenarios, role plays or group assignments. Virtually all of them are designed to support specific pedagogical approaches and learning objectives and therefore do not support the concept of reuse of invested resources. Hornik, Johnson und Wu (2007) mentioned in this context: *"[...] the technology should be flexible enough to adjust the multiple user's belief, as some users may no be able to adapt their preferred learning model to the one supported by the technology."*

This situation outlined so far motivated to initiate a first proof of concept towards flexible systems which supports configuration and adaptation of virtual learning environments according to the learning communities' specific needs.

The output of this work is the prototype called 'Second Life Room Manager'. It is a web based tool which provides learning environments in Second Life in a totally flexible and adaptable way. In addition, the tool creates the specific setting on-demand. Students or lecturers can prepare their preferred learning situation out of Virtual World without any particular knowledge of Second Life programming or scripting.

This project is a cooperation of Curtin University of Technology (Western Australia) and Graz University of Technology (Austria).

1.2 Structure

Generally, this paper is structured in several parts. It begins with three Chapters of theoretical research, followed by the project 'Second Life Room Manager' and ends with the 'Lessons Learned' and a 'Summary and Outlook' about the whole thesis.

In particular the research starts with (i) Virtual 3D Worlds (ii) Learning Management Systems and (iii) Learning Environments in Virtual Worlds.

A definition, a historical review, how Virtual Worlds distinguish in their topology and attributes and the current most important virtual worlds are part of this Chapter 2.

After that, LMS get considered in detail. What are 'Learning Management Systems', the development from the past, their different architecture in detail are discussed in Chapter 3 as well as the different types of LMS. In the end of this unit the problems, like social drawbacks or security issues will be considered in particular.

The last Chapter, of the theoretical part, is called 'Learning Environment in Virtual Worlds'. It shows current examples about learning environments in Second Life, demonstrates their advantages and disadvantages and what ideas could be use for the practical project in this work.

Chapter 5 describes the project 'SLRoomManager' in its practical development. 'SLRoomManager' is a flexible web-interface to manage Second Life educational environments in an easy way. It contains the items (i) Design; with the creating and finding of the requirements (ii) Development; The actually transpose of the application with their subparts like, Web-Interface, Background-Interface, Second Life Realization and more (iii) Findings; The benefits and the new insights from this project from the developers and the users point of view.

Chapter 2

Virtual 3D Worlds

"I think this is the biggest thing since we landed on the Moon," says Jaron Lanier, the dread-locked CEO of VPL Research. (Who was 9 years old at that time.) I don't choke on that one. Indeed, I'd take it a bit farther, guessing that Columbus was probably the last person to behold so much usable and unclaimed real estate (or unreal estate) as these cybernauts have discovered." (Barlow & Perry, 1990)

This important citation is from Jaron Lanier in 1990, CEO of VPL Research from 1984 till 1990, a company to provide and develop virtual reality application. He already realized how important and large virtual worlds should be in future. The following Chapter gives an overview and definition about 'Virtual Worlds'. How they can achieve such growth, and which are the most important and popular.

2.1 Definition

All available Virtual Worlds are special in their own way. Kock (2008) tried to define Virtual Worlds in their common structure by followed:

"Virtual worlds can be defined as environments created by technology that incorporate virtual representations of various elements found in the real world. Among those elements are virtual human beings with whom one can interact, virtual physical environments that include land and oceans, and virtual objects like chairs and tables." (Kock, 2008)

In almost the same manner Müller und Leidl (2007) wrote about Virtual 3D Worlds that they could be defined as an extension of the Internet in three-dimensionality. The difference to conventional Internet applications is the use

of a client software instead of a browser. Users are able to interact in a virtual room through an avatar with the assistance of a keyboard and a mouse.

Another way to describe or define virtual worlds is to list their common attributes. Referring to this, Latteman (2009) and Castronova (2001) show the following result:

- *Immersion*
Describes the feeling of the user to be part of the virtual environment through his avatar (Magnenat-Thalmann, Kim, Egges & Garchery, 2005). They are able to shape their vicinity, move around and distinguish movements of other communication partners.
- *Consistence*
Describes the same or similar detection of object of the users of a virtual world. These objects can be subject to copyright, user rights or are traded using a virtual currency (Bartle, 2003).
- *Persistence*
Describes the attribute that virtual worlds are able to continue existing after an avatar is leaving the system. The created objects of this user are still available and may be changed by others (Franceschi, Lee & Hinds, 2008).

Castronova (2001) finds two more characteristics of virtual worlds:

- *Interactivity*
It exists on one computer but can be accessed remotely (i.e. by an internet connection) and simultaneously by a large number of people, with the command inputs of one person affecting the command results of other people.
- *Physicality*
People access the program through an interface that simulates a first-person physical environment on their computer screen; the environment is generally ruled by the natural laws of Earth and is characterized by scarcity of resources.

2.2 History

The idea of virtual reality or virtual worlds is older than many people might think. Yet Morton Heilig already developed an immersive virtual reality technology in the 1950s called 'Sensorama' (Figure 2.1). It was able to simulate odors (Kock,



Figure 2.1: Sensorama to simulate odors
(Kock, 2008)

2008).

But the first idea of a virtual room, which was similar to present platforms, where multiple users can login at the same time, got realized 1986. The 'multi-participant on line environment' got developed by 'Lukasfilm Games' for the C-64 computer (Farmer, 1992). Unfortunately the application was not really attractive for users because of the simple graphic and the complexity of the programming. A short time later 'Active Worlds' (1995) and 'Moove Online' (1997) developed virtual rooms where users could create and present contents and interact with other users. Both platforms are still available. The main reason for the successful establishment was the more powerful graphic card in private computers, the increased bandwidth of networks and the paced development process of 'MMORPGs (Massively Multiplayer Online Role-Playing Games)' (Müller & Leidl, 2007)

Nowadays, we have a lot more different Virtual 3D Worlds. Table 2.1 shows a ranking of most important MMORPG platforms.

An interesting point is that 'Sun Microsystems' product 'Open Wonderland' is not listed in this ranking. The reason is that Open Wonderland is not running on servers which are available for everybody. That demonstrates the main differences of the most important virtual worlds. They will be discussed in the next

Section 2.3.

Platform	Owner	Accounts
Second Life	Linden Lab	15 million
World of Warcraft	Blizzard Entertainment	11.5 million
Sony Playstation Home	Sony Playstation	12 million
The Sims 3	Electronic Arts	3.7 million
IMVU	IMVU Inc.	20 million
Blue Mars	Avatar Realty	3000
Uthervers	Uthervers Digital Inc	600.000
Kaneva	Kaneva Inc	800.000 (2008)
Active Worlds	Active Worlds	2 million
Meet Me	Transcosmos Inc	
RuneScape	Jagex Ltd	5 million
HiPiHi	HiPiHi Co. Ltd	10.000 (2007)
A World of My Own (AWOMO)	Virgin Games	
Moove	moove Bongartz-Dr. Kozan GbR	760.000
Google Lively	Google	Closed
There.com	There Inc (MTV Networks)	Closed

Table 2.1: Virtual 3D Worlds Ranking
 (SecondLifeUpdate, 2007; Reinwand & Reinwand, 2008; Allen, 2007;
 Activeworlds, o. J.; Klaus, 2008)

2.3 Typology of Virtual Worlds

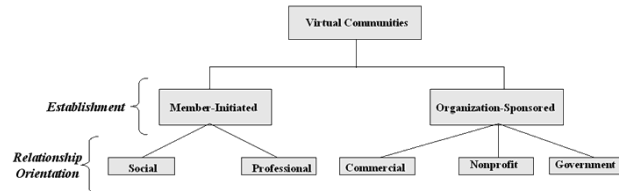


Figure 2.2: Topology of virtual communities
(Porter, 2004)

Organization-sponsored communities are communities that are sponsored by either commercial or non-commercial organizations.

As discussed in Section 2.1 there are a lot of different virtual worlds available. An interesting point is how the virtual worlds can be distinguished. Porter (2004) starts to divide them in different virtual communities. The first level includes two categories (Figure 2.2): Member-initiated and Organization-sponsored. Member-initiated communities are those in which the virtual platform is managed and established by members.

The relationship orientated level refers to the type of relationship fostered among members of the community. Member-initiated communities foster either social or professional relationships among members. Organization-sponsored communities fosters relationships both among members (e.g., customers, employees) and between individual members and the sponsoring organization.

Lee, Vogel und Limayem (2003) review several typologies, but concludes that none of the classifications of virtual community covers every aspect, or fits under every circumstance.

2.4 Attributes of Virtual Communities

Even more important are different attributes of virtual communities and virtual worlds. Porter (2004) defines five main attributes to characterize virtual communities. P. Messinger, Stroulia und Lyons (2008) describe them in detail as following:

- *Purpose*
(Content of Interaction): Porter focuses on the specific type of information or contents being communicated among the virtual community. We focus on (a) whether a game has a strategic, tactical, or thematic appeal, (b) whether the network is themed (has a specific purpose) or is open, and (c)

for virtual worlds, whether there is an age focus, a contents focus, or it is open.

- *Place*
(Location of Interaction): Porter focuses on whether the notion of place is completely, or only partially virtual. We also consider whether players are collocated or geographically dispersed.
- *Platform*
(Design of Interaction): We follow Porter by focusing on synchronous communication, asynchronous communication, or both. In addition to looking at PC platforms connected by the Internet, we also include various gaming platforms.
- *Population*
(Pattern of Interaction): We follow Porter by focusing on the size of the group. Porter also considers the types of social ties; we consider distinguishing characteristics of the target user market.
- *Profit Model*
(Return on Interaction): Porter focuses on revenue or non-revenue generating environments. We elaborate on her taxonomy by examining whether the world supports (1) a single purchase price or registration fee (i.e., fixed fee); (2) fee per use (i.e., variable fee); (3) subscription based (and on what basis subscriptions are made); (4) advertising-based; (5) pay-as-you-go extras (virtual assets including clothing, land, and software); and (6) sale of ancillary products, such as real stuffed animals and accessories, which are accompanied by passwords for accounts in virtual worlds where virtual versions of the products enable combined real and virtual play.

2.5 Educational usage of Virtual Worlds

Virtual Worlds offer many opportunities in terms of education. They provide a range of experiences, some of which are impossible to try in the real world. Reasons for that can be distance, cost, danger or impracticability. (Chittaro & Ranon, 2007)

Below, some arguments found in Chittaro und Ranon (2007); Dalgarno und Hedberg (2001); O'Driscoll, Trondsen und Cross (2007) describing positive affects that arise using 3D-worlds are presented:

- *Being part of the community*
With the ability to communicate with other avatars, the user feels as being part of a community.
- *Try to get experience in a safe way*
In different kinds of research training can be difficult or unsafe (high costs; security issues). In VW people can gain experience in their field by practicing up to a point until they are completely satisfied.
- *Better communication*
Almost all Virtual Worlds offer VOIP (Voice over IP) as an embedded system. This can improve the communication between students and lecturers.
- *Understanding of complex structures*
Sometimes it is difficult to imagine structures. In Virtual Worlds these complex buildings can get realized and users can observe them from different angles to improve their understanding.
- *Watching other learners*
If a student watches other students create spectacular objects it can animate to share knowledge collaboratively to achieve higher goals.

Within these advantages Virtual Worlds have a lot of reasons for being popular for education. According to that, Holmberg (2005) stated: "*Second Life produces a more realistic feel of presence than discussion forums or chat rooms.*" Thus it can be concluded that VW might enhance distance learning since the lacking sense of presence is a fairly known issue in distance education. (Section 3.5.1)

2.6 Currently Important Virtual Worlds

It is not easy to find the most popular virtual world. You cannot just count the sold units with every environment. There are two different ways to define the most popular and most common virtual worlds. The following Sections describes these methods.

2.6.1 Sign ups

Sivan (2008) compared the subscriptions of more than ten different worlds from April 2003 to December 2007 (Figure 2.3). It is easy to see the rapidly growth of World of Warcraft and Second Life in their amount of sign ups. Second Life had about twelve million and World of Warcraft about ten million accounts at

the end of 2007.

In the present Second Life has much more accounts than World of Warcraft. Second Life is publishing there statistic as a raw format in the web (Linden Research, 2010b). The website of 'taterunino'¹ prepares this data in appropriate charts (Figure 2.4). Thus, Second Life has approximately twenty million sign ups currently since their launch.

Blizzard Entertainment, the owner of World of Warcraft, is not providing such a statistic in detail, like Linden Lab. They just publish regular press release on their website with the amount of sign ups. The last one was in December 2008 with 11.5 million subscribers worldwide (BlizzardEntertainment, 2008).

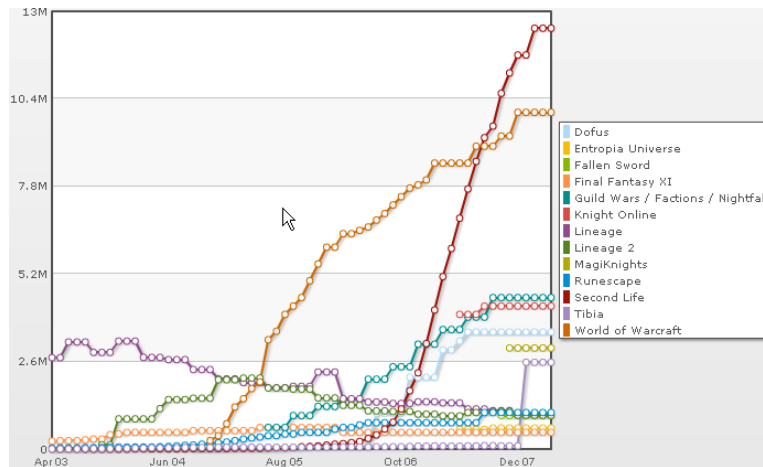


Figure 2.3: Growth of different Virtual Worlds
(Sivan, 2008)

¹<http://www.taterunino.net>

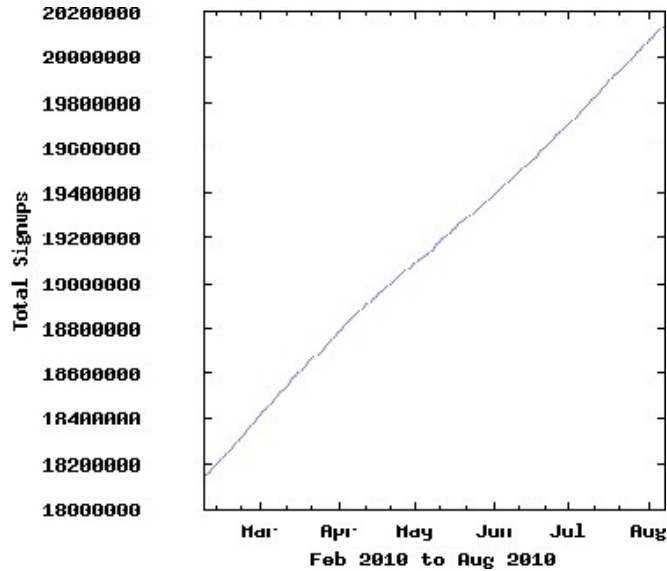


Figure 2.4: Second Life Sign Ups
(Nino, 2010)

2.6.2 Average Concurrent Player

A different way to define the attractiveness of virtual worlds is to compare the average concurrent users. Again Nino (2010) offers a chart (Figure 2.5) about a 14 days statistic of simultaneously logged in users.

According to that, Second Life has between 40.000 and 70.000 concurrent avatars online.

It is more difficult to get similar data about World of Warcraft. WoW is running on different servers. Blizzard Entertainment is operating around 240 servers currently (Worldofwarcraft.com, o. J.). The website of 'warcraftrealms'² offers an average utilization with an around 600 users per server (Figure 2.6), thus results in 144.000 concurrent users playing at Blizzard Servers.

To put it in a nutshell, Second Life has more registered users, but World of Warcraft has more durable players.

²<http://www.warcraftrealms.com>

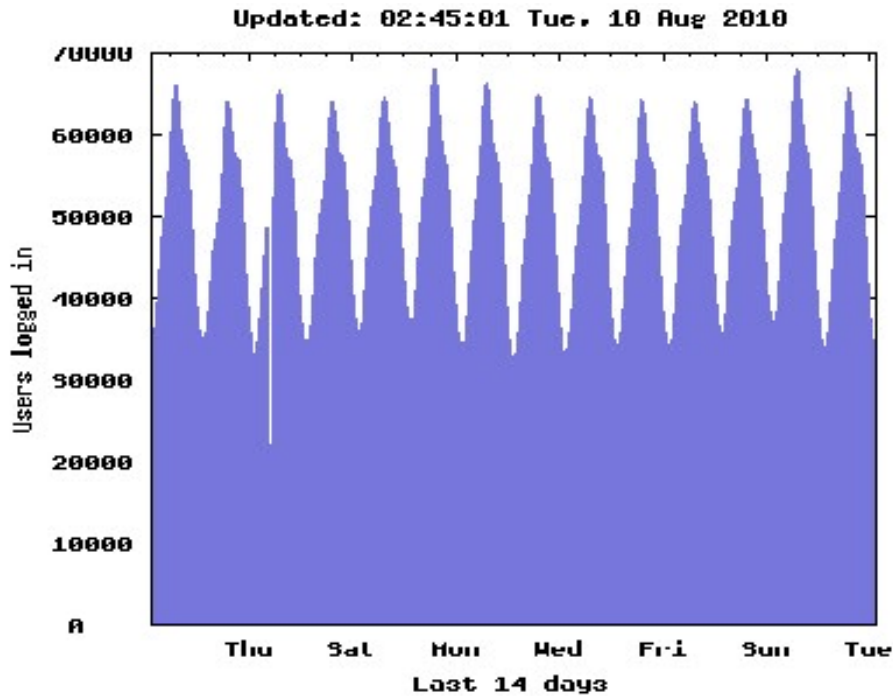


Figure 2.5: Concurrent Users in Second Life
(Nino, 2010)

2.7 Second Life

The previous Section provided an overview of the most popular virtual worlds. Second Life is the platform with most registered accounts, thus we start to take a look at this virtual world in detail. The following historical growth is based on P. R. Messinger et al. (2009).

2.7.1 Features

Publicly launched in 2003 by Linden Lab and considered by some to be 'motherlode' game, Second Life is really a massive technological and social experiment. In this virtual world, residents can shape the world around them, particularly their virtual property, which is located on simulators (or sims, for short). Residents can write code to manipulate the environment, trade objects and land for money, make or purchase their own clothes, participate in group activities, work, explore, play, and interact socially. Collectively, residents own millions of objects, including buildings and structures in all possible architectural styles,

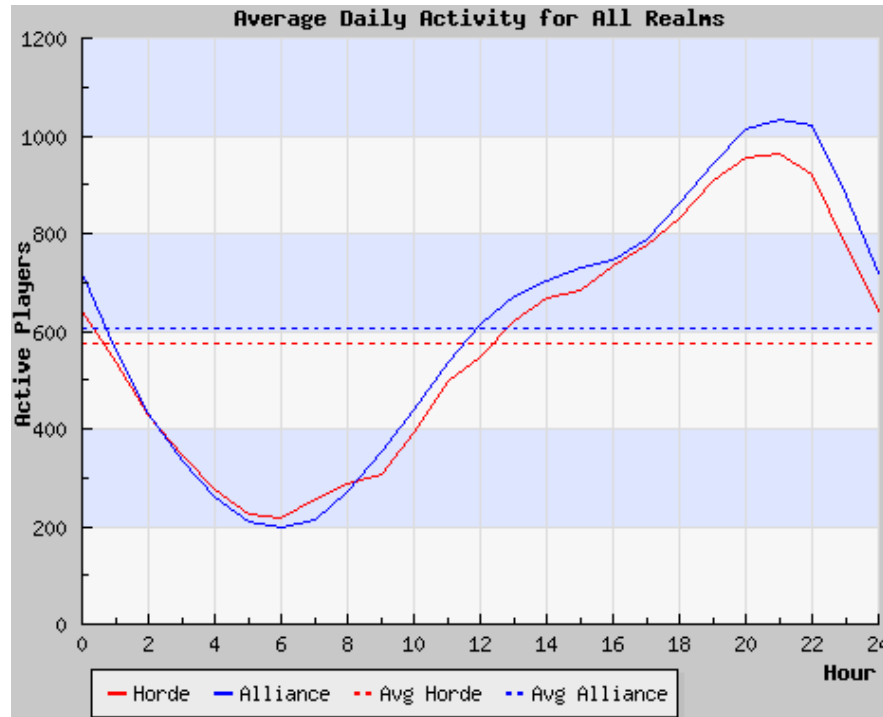


Figure 2.6: World of Warcraft statistic
(WarcraftRealms.com, 2010)

clothing and furniture in classic to avant-garde fashions, cars, boats, and planes, and numerous virtual products – all created in an enormous virtual economic ecosystem. Because of that, every SL-user buys virtual land to house a building, create furniture, vehicles or other items. In real-world terms, what the residents are doing is leasing software capacity on a server. (P. R. Messinger et al., 2009)

2.7.2 Technology

Already in 2007, Second Life had problems with the rapid growth (around 20%) of concurrent users. According to Wagner (2007), all Second Life data is stored in two different facilities in San Francisco and Dallas. All software is open source, therefore SL is running on Debian Linux and MySQL database.

The architecture is similar to the virtual world which it is creating. Each geographic area runs on a single instantiation of server software, called a simulator or 'sim' and each of them is running on a separate processor on a server. Thus, when a resident walks from one sim to an adjacent sim, it's actually a moving from one processor or server to another.

2.7.3 System Requirements

A Second Life Viewer application is available for Windows, Linux and MacOs. The following Table 2.2 presents the minimal system requirements of Windows PCs. More detailed information can be found at SecondLifeWiki (2010f).

Internet Connection	Cable or DSL
Computer Processor	800 MHz
Computer Memory	512 MB or more
Screen Resolution	1024x768 pixels
Graphics Card	NVIDIA GeForce 6600 or better

Table 2.2: Second Life System Requirements for Windows (SecondLifeWiki, 2010f)

Costs

Every avatar starts as a free basic account. But these users are restricted, for example, they can not buy land (Linden Research, 2010c). To upgrade an account to premium it costs about 12 USD monthly, or 86.40 USD annually. Much more expensive is the ownership of land. Table 2.3 shows the fees, parcel size and allowed prims per parcel in relation to the land.

Additional Land (over 512 sqm)	Parcel Size	Prims per Parcel (approximate)	Monthly Land Use fee
1/128 Region	512 sqm	117	5 USD
1/64 Region	1,024 sqm	234	8 USD
1/32 Region	2,048 sqm	468	15 USD
1/16 Region	4,096 sqm	937	25 USD
1/8 Region	8,192 sqm	1,875	40 USD
1/4 Region	16,384 sqm	3,750	75 USD
1/2 Region	32,768 sqm	7,500	125 USD
Entire Region	65,536 sqm	15,000	195 USD

Table 2.3: Land use fees in Second Life (Linden Research, 2010a)

2.8 World of Warcraft

"In the outside world I'm a simple geologist, but in here, I'm Falcon, defender of the alliance." (SouthParkStudios, 2006)

This quotation is from the comic series 'South Park', who devoted in 2006 an entirely episode to World of Warcraft. It showed the popularity and possible addiction to this game in a funny way. World of Warcraft is not a typical Virtual 3D World like Second Life. According to Section 2.6, it is the most visited MMORPG in the web. This is enough reason to take a look at this game in detail.

2.8.1 Features

According to Nardi und Harris (2010), World of Warcraft (WoW) is a game in which players create characters, their avatars, with distinctive looks and qualities such as intellect, strength, stamina, and agility. Characters advance through 80 levels of play. They acquire equipment such as swords, armor, jewelry and develop different skills.

WoW entails killing monsters, exploration, quests, and playing on battlegrounds as well as more restful pursuits such as crafting, chatting with friends, and spending time in cities for banking, training and trading. The players have to decide which race and class they want to play. The races are Night Elf, Dwarf, Gnome, Human, Dranei, Troll, Orc, Tauren, Undead, and Blood Elf. Classes are druid, priest, warrior, rogue, mage, hunter, paladin, shaman, warlock, and death knight (Nardi & Harris, 2010).

WoW offers different player mode. The characters can fight against each other in specific areas or on 'battle fields'. Similar they are able to play together against NPCs (Non Player Character; pre-programmed characters) in a group, called guilds. The communication in this guilds is most of the time based on 'Teamspeak' (a groups telephony program). Based on (Pestal, 2008), the membership in a guild promotes the consumption game and more then 80,6% are member in such groups.

Economy in Wow

As mentioned, avatars in World of Warcraft are based on levels. Thus, players try to level up their characters as high as possible and equip them with good accessories. This requires many quests to be fulfilled and defeated competitors which takes much time and patience in claim. But a lot of people do not have that



Figure 2.7: Screenshot of World of Warcraft
(BlizzardEntertainment, 2010b)

time and patience to play so long until they have a good avatar. This phenomenon was recognized by players in China as a market gap. According to Pestal (2008), in 2006 around 100.000 kids earned money with leveling up characters and selling items. The business is carried on 'eBay', the products and characters are passed 'ingame'. Most customers are found in Europe and USA, they have more interest in the group playing than in the tedious leveling up of characters (Pestal, 2008).

2.8.2 Technology

World of Warcraft is divided into 4 different types of server: 'normal' or 'player versus environment' (PvE), 'player versus player' (PvP) and 'role playing' (RP). A user is able to create characters on lots of different servers, but characters cannot communicate across servers unless they are on the same battleground.

When the user is logging into the virtual world, they use first a authentication server. It verifies name and password and then it transfers the avatar to the realm - server which the user played last.

Every server has a database function running. It provides information on the locations and respawn time all of the items a player can interact. All informations about the character, including quests, level and gear are stored in a database which is tied to their World of Warcraft account, which is connected to the WOW website. If the user wants to move his account to another server, Blizzard Entertainment charge a small fee to adjust the database entries. (T. V. Wilson,

2007)

2.8.3 System Requirements

World of Warcraft is available for Windows (Win XP and better) and Mac. The following Table 2.4 shows the minimum requirement for a computer running with windows.

More detailed information can be found at BlizzardEntertainment (2010a).

Computer Processor	Intel Pentium 4 1.3 GHz or AMD Athlon XP 1500+
Computer Memory	512 MB RAM (1GB for Vista users)
Storage	15 Gigabytes or more free hard drive space is required
Video	3D graphics processor with Hardware Transform and Lighting with 32 MB VRAM

Table 2.4: WoW System Requirements for Windows
(BlizzardEntertainment, 2010a)

2.9 Open Wonderland

"The aim of Project Wonderland is to improve the communication, allow ad hoc communication and realize application sharing. It is addressed to companies, not for huge worlds with as much people as possible, more as a controlled world to increase the efficiency of work."
(Hofweber, 2008)

Wonderland is a toolkit to develop interactive virtual 3D worlds designed by Sun Microsystems. On January 27, 2010, Sun Microsystems was acquired by Oracle (OracleCorporation, 2010) who decided to cease funding (Yankelovich, 2010). Project Wonderland is now continuing as an independent community-supported open-source project named 'Open Wonderland' (Korolov, 2010).

Motivation to develop Open Wonderland, was, that Sun had a lot of home-office staff all over the world. To increase their collaboration work, Sun wanted to create an environment where employees could do location-independent meetings. Open Wonderland launched such a platform. Wonderland is 100% JAVA based, uses the JAVA 3D libraries and is thus platform-independent. (Hofweber, 2008) The client and server are open source and can be downloaded for free on the Open Wonderland website³, as well as the entire source code of the project. This

³<http://www.openwonderland.org>

enables a lot of opportunities for the developer. Anyone is free in their creativity and can shape the world according to their wishes. (Collins, Bentley & Conto, 2008)



Figure 2.8: Screenshot of Open Wonderland
(world2worlds, 2008)

2.9.1 Features

As in other virtual 3D worlds, a user interacts via an avatar. These avatars can speak, work on applications together or participate on conferences. Wonderland offers the opportunity to share applications. You can attach these applications on virtual walls to get observed by other avatars. A user can attach every application on walls which are running on a Wonderland client computer. For example, if you want to discuss a website, just open the URL in a browser and attach it on

a wall.

Another feature is 'conferencing'. In furnished conference rooms it is possible to make phone calls into the 'real world' or opposite. Further 'Panorama view' is a application to integrate live videos into Wonderland. It is used to show live conferences in Wonderland via web cam. (Hofweber, 2008)

2.9.2 Technology

Wonderland is completely based on the open source technology JAVA. The server infrastructure 'Project Darkstar', with the main aim to simplify the development of online games, virtual worlds and social network applications. More information can be found under RedDarf (2010).

For the representation of the 3D world Open Wonderland used Java3D with the concept of scene graph till the version 0.5. Since that, 'jMonkey' works as the graphic engine for the virtual world. It provides a simple particle system, a terrain engine, 3D-Sound-Support and real time water simulation. (Wiki, 2010)

In Wonderland, it is also possible to transmit voice. To use this feature, it is necessary to install the packet 'jVoiceBridge', with controls recording ,playback and volume of tones. Project 'Looking Glass' is another technology in Wonderland. It is a scene manager which enables the possibility to integrate external programs. (Callaghan et al., 2008)

2.9.3 System Requirements

According to OpenWonderland (2010), the minimum requirements for a Wonderland server suitable for software development are the same as the requirements for running the client. A Wonderland server plus one or two clients can comfortably run on a high-end desktop or laptop. The following Table 2.5 shows the minimum system requirements for a windows computer.

Computer Processor	1.5Ghz+
Computer Memory	1GB
Graphics Card	128MB+

Table 2.5: System Requirements of Open Wonderland
(OpenWonderland, 2010)

2.10 Open Simulator

OpenSimulator, or OpenSim for short, is a free implementation of a virtual world platform, utilizing the 'Second Life Protocol'. (Childers, 2009) Thus, it can be used to simulate virtual environments similar to Second Life.

In the FAQ, of the Open Wonderland website⁴, the virtual world is defined as followed.

"OpenSim is a platform for operating a virtual world, and supports multiple independent regions connecting to a single centralized grid. This is somewhat similar to the web, where anyone can run their own web server, tied together through the Internet. It can also be used to create a private grid, analogous to a private intranet."
(OpenSimulatorWiki, 2010d)

In other words, it is an open source platform for hosting virtual worlds and is compatible with the Second Life protocol. Thus the user can use several different viewers to connect to OpenSim. Currently, Table 2.6 shows the compatible viewers.

Linden Client	Release version is the only fully supported viewer
Hippo Viewer	A fork of the Linden Client with OpenSim specific enhancements
RealXtend	a fork of the Linden Client that has specialized features (is not fully supported yet.)
Meerkat Viewer	another LL-based viewer
Emerald Viewer	The latest viewer based on LL code but extended with some nice features

Table 2.6: Compatible Viewers for Open Sim
(OpenSimulatorWiki, 2010c)

2.10.1 Features

As mentioned, OpenSimulator is an open source version of Second Life. Because of that, it supports most of the features of Second Life. But it is easily expandable though the use of plugin modules and several modified distributions exist. According to OpenSimulatorWiki (2010e), Table 2.7 shows the features in detail.

⁴<http://OpenSimulator.org>

- * Supports online, multi-user 3D environments as small as 1 simulator or as large as thousands of simulators.
- * Supports 3D virtual spaces of variable size within one single instance.
- * Supports multiple clients and protocols - access the same world at the same time via multiple protocols.
- * Supports realtime Physics Simulation, with multiple engine options including ODE.
- * Supports clients that create 3D content in real time.
- * Supports inworld scripting using a number of different languages, including LSL/OSSL, C#, JScript and VB.NET
- * Provides unlimited ability to customize virtual world applications through the use of scene plugin modules.

Table 2.7: OpenSimulator Features
(OpenSimulatorWiki, 2010e)



Figure 2.9: Screenshot of OpenSimulator
(OpenSimulatorWiki, 2010f)

2.10.2 Technology

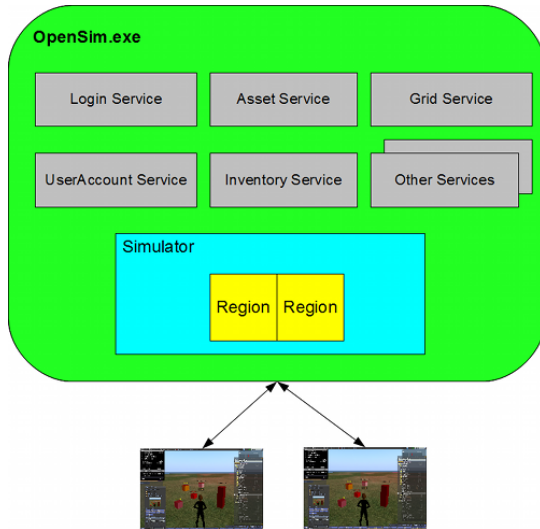


Figure 2.10: OpenSimulator in Standalone Mode
(OpenSimulatorWiki, 2010b)

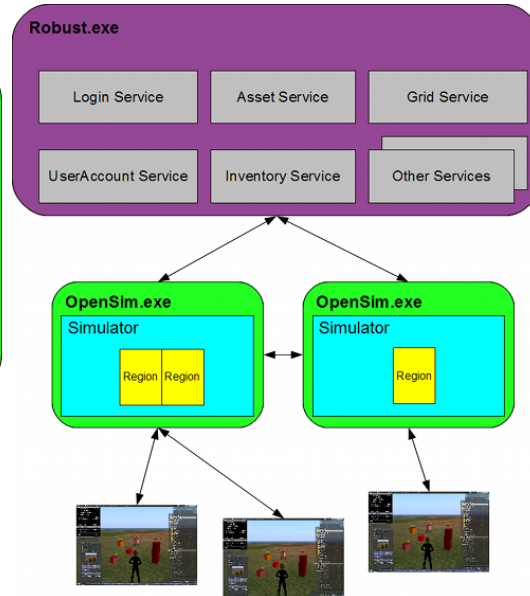


Figure 2.11: OpenSimulator Grid Sample
(OpenSimulatorWiki, 2010b)

OpenSimulator can operate in two different modes, standalone or grid mode. The following Sections describes these modes in detail and is based on OpenSimulatorWiki (2010b).

Standalone Mode

In the 'Standalone Mode' every service runs in a single process. The user can run as many regions as he likes, but only on a single machine. Figure 2.10 shows that the process 'OpenSim.exe' handles every service, such as the 'Login Service', 'Grid Service", and as well the 'Simulator Service'.

Grid Mode

In 'Grid Mode', the data services are part of the 'Robust.exe' process (Figure 2.11). A Robust shell can run all services or can be split amongst any number of Robust instances, which allows them to run on entirely separate machines. On the client side, multiple 'OpenSim.exe' processes, on different machines, can be used to access to several regions.

Scripting

In-world programming, or scripting, is really important for the OpenSim developer. Almost 70% of Second Life Scripting functions already got adapted in OpenSim. An implementation of the missing functions is being planned, but there are also other scripting languages (for example C#) or their own command extension 'os'-commands. These are often more powerful and more useful in terms of security risks. (OpenSimulatorWiki, 2010e)

2.10.3 System Requirements

The minimum requirements for an OpenSim Server are not really high. The important part is the '.NET Framework 2.0' or higher on a windows running computer or 'mono' on a unix. The following Table 2.8 shows the other minimum system requirements and is based on OpenSimulatorWiki (2010a).

Internet Connection	DSL or ADSL
Computer Memory	256 MB
Software Platform	.NET Framework 2.0 or higher, mono 2.01 or higher

Table 2.8: System Requirements of OpenSim
(OpenSimulatorWiki, 2010a)

2.11 There



Figure 2.12: Screenshot of There
(Gardenvale, 2007)

The virtual 3D world 'There' launched in October 2003, was developed over 6 years and ran in beta test over one year. There got developed by There.inc, in the meantime the company was divided into 'Forterra Systems' and 'Mekena Technologies'. There is a persistent world with objects which can be adapted by users. As usual, a user is represented by an avatar to many opportunities to interact with other people. In this virtual 3D world social skills and games are in focus. For example, they are organizing buggy races, paint ball or similar games. (Brown & Bell, 2004)

2.11.1 Features

Objects in There

As other virtual 3D worlds, 'There' concentrates on objects. Objects can be created, bought or sold by users. But the trading system of virtual objects has a big disadvantage concerning to other worlds. It is only realized as 2D and single interface. Thus, a main task in 'There' namely, shopping, ends in a single user activity. This need for price negotiations a regular change between the shopping and viewer interface. (Brown & Bell, 2004)

Developer Program

To create objects in There, the user has to become a member of the 'developer program', which requires a premium membership. Thus, it is possible to download tools to create and design new objects. The providing of objects costs money. For each new object There.inc charges the creator a commitment fee and a sales charge. These costs get set up by There for different kind of products and are published in a price list. Roughly speaking ten sold pieces can pay off the commitment fees. (Brown & Bell, 2004)

There Today

Unfortunately the project 'There' got closed on March 9th, 2010. The CEO, Michael Wilson, says that the reason in to be found in the financial crisis and that it is the recession that has to cut back the turnover. (M. Wilson, 2010)

"It's been our privilege to play a small part in making the place that was There.com, and for that we thank you. We know that There will continue to live in our hearts and minds, and hope it does in yours, too." (M. Wilson, 2010)

2.12 Discussion

The statement of Jaron Lanier, that Virtual Worlds are the biggest achievement since we landed on the moon, is hard to believe. (Barlow & Perry, 1990). Many companies thought the same and tried to jump on the train of the VW wave of success. But as statistics shows, many Virtual Worlds already have been closed. That raises the question, what differentiates the successful and less successful worlds.

Most of their attributes, like communication, interaction or the interface, are similar. But still not every platform has survived in the tough competition. It is emphasized that users are fascinated, captive and it should be hard to stop being online, to survive with a virtual 3D world. As Blizzard Entertainment shows, if the users are drawn into the spell, it is not a problem to make money with them. But it is not always a compelling story and engaging community that leads to success. Second Life provides an almost free and customizable world where users can unfold themselves however they want and are successful with this theory as well.

The idea, that everything was created by users, seems to lead success. It is also an important part of education in Virtual Worlds. As discussed the advantages are: (i) Being part of a community (ii) Getting experience in a safe way (iii) Better communication (iv) Easier understanding of complex structures and (v) Learning by watching. This follows automatically to many educational applications. According to Freitas (2008), there are already many environments and virtual land with educational tools and content. He also mentioned about game-based learning: *"[...] the powerful nature of learning from doing and learning with others is maximized in simulation - and game-based learning. We can learn from doing through playing and enacting situations, problems and challenges, and at the same time we can learn socially from watching others and replicating behaviors in those we observe around us."*

Chapter 3

Learning Management Systems

Over the last decades, teaching and learning have been influenced by technology, like motion pictures, radio, television or computers. This generation - children who grew up with these technologies - uses technology anytime, everywhere and for any purpose, like learning. (Gütl & Chang, 2008)

This Section gives an overview of e-Learning, in particular Learning Management Systems, how they support educational processes in detail. It discusses the definition, the historical background and the architecture of 'Learning Management Systems'. Furthermore, also different types and their distinctions and the big market of LMS will be covered in this Section in detail.

3.1 Definition

Defined by Roberto Barchino (2005), a Learning Management System, or LMS for short, "*[...] is a complex software system which provides learning content and manages learning processes.*"

According to Schulmeister (2005), the 'EDUCAUSE' institution¹ and the company 'IMS Global Learning', a LMS should provide the following attributes:

- *Courses*
The technology should enable the establishment and operation of courses.
- *Actors*
LMS should offer the following roles for the actors: students, lecturers, tutors and administrators.

¹<http://www.educause.edu>

- *Services*
Services must have the following functionality:
 - Administrative services: course calendar, black wall, etc.
 - Communication services: Chat, Email, Forums.
 - Teaching functions: Slides, References into the web, etc.
 - Evaluation services: exams, self-evaluation, etc.
- *Documents*
Documents must be part of learning objects at services.
- *Groups*
The technology should provide collaborative work and communication between users.
- *Institution*
The learning environment should be adaptable for every institution.
- *Language*
The technology should support courses in different languages.
- *Interface*
The technology should allow the adaptation ability of the user interface to the learning environment.
- *Navigation structure*
The technology should offer the adaption ability of the navigation to the learning environment.

That is a lot of attributes and functions, which should offer and support a Learning Management System, and referring to Schulmeister (2005) no learning platform has fulfilled all these requirements so far. Schulmeister (2005), supported by Roberto Barchino (2005), reduced and simplified the needs to the following functions:

- *User Management*
An encrypted and secure Log-on.
- *Course Management*
Management of courses, course content and files.
- *Role and Rights*
A role and rights allocation with differentiable rights.

- *Communication*
Chat, forums, white board, notebook, calendar, etc.
- *Presentation*
A network-enabled browser to present course content, learning objects.

Thus, the main task of a Learning Management System, is to manage learning contents from the creating or uploading to the present and provide the data as well as support for all processes with communication tools.

3.2 Architecture

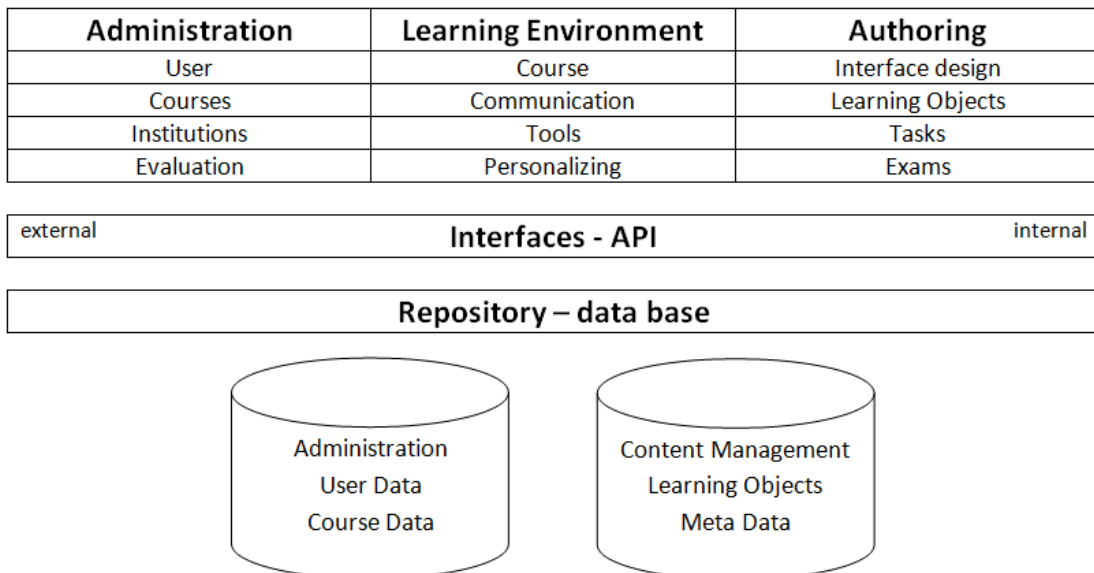


Figure 3.1: Ideal typical architecture of a Learning Management System
Schulmeister (2005)

This diagram (Figure 3.1) shows the layer of an ideal typical architecture and the organization of a Learning Management System. Main tasks for the different layers are: (i) Repository: This part stores all data, like learning objects, account data etc. (ii) Interfaces - API: It offers the access for internal or external applications (iii) Visualization: The highest layer is used to illustrate the data and to control the learning platform.

In normal operation, all access works through the highest layer three. Sometimes LMS have adjustments or extensions. Thus, these add-ons access via layer two

on the database to the learning objects. (Bungenstock, 2006; Schulmeister, 2005) A good example for this is Sloodle. It is an external service which provides learning contents in Second Life and will be discussed in detail in Section 4.1.

3.3 History

The history of Learning Management Systems is based on the historical development of e-Learning in general. This Section gives a short overview of the growth of e-Learning and Learning Management Systems in particular and accords with UniversityofWisconsin (2005) and Simon (2001).

Already in the 1920 Sidney L. Pressey, an educational psychology professor at Ohio State University USA, developed the first 'teaching machine'. It was able to evaluate automatically multiple-choice-exams. The student had to type the number of the answer into the machine. When the answer was right, the machine jumped to the next question. At the end, the machine showed the number of wrong answers.

According to Simon (2001), B.F. Skinner is the father of Learning Management Systems. In the fifties, he developed one of the first machines to support learning. Skinner tried to make learning more efficient with the individual access to learning materials.

The machines were pretty simple. On wheels and discs single short course units were shown and the students had to work through every single one. The answer was given by a keyboard or for an open question by pen. These machines worked with frames, where different learning programs had been installed. It offered simple spelling and arithmetic programs for young kids and courses for university units about behavioral research.

The first German learning machine was 'ALZUDI' (algorithmic mapping didactics). It was developed at 'Educational University of Berlin'. The goal was to map foreign words to German terms. The machine created variable programs for different words with a paper tape, thus it generated a learning program itself.(Kerres, 2001)

Through the rapid technical progress in the sixties and seventies, the universities got a massive pressure to increase the development of e-Learning systems. The University of Illinois started the project 'PLATO'², with the goal to develop a mainframe based learning information system. Similar projects were started at Standford University and at Pennsylvania State University. Almost at the same time, IBM presented the programming language 'COURSEWRITER', which should reduce the complexity of the development process.

²<http://thinkofit.com/plato/dwplato.htm>

The nineties did not show a big change. Most of the development was done by universities. Just at the end of the decade, companies of document-management-solutions, like IBM/Lotus (Learning Space) and Hyperwave (e-Learning Suite), started to bring Learning Management Systems on the market.

At the beginning of the 21st century, the European Union started a research project, called 'Ariadne'³. Goal of the foundation is to reuse digital learning objects through a knowledge pool system and to set up a European or worldwide network of universities, organizations and companies, to post their learning contents and modules to enable other members to reuse this objects based on the principle "share and reuse". (Kandzia, 2003)

The researchers of 'Ariadne' and of the American IMS-project worked together on the development of the 'IEEE Learning Object Metadata (LOM)' standard. This standardized description of learning material shows necessary prerequisites for the development of knowledge media.

IEEE Learning Object Metadata

The Learning Object Metadata (LOM) got defined by IEEE in 2002. They distinguish between two categories: 'active' and 'expositive'. The first class describes more interactive objects and the second term would be assigned to files, like text-, presentation, audio or video-documents. (IEEE, 2002)

Meta data is necessary to support these Learning Objects, which describe themselves and make connections to other e-Learning objects possible. The IEEE LOM standard (IEEE, 2002) supports following attributes for meta data:

- General
- Lifecycle
- Meta-metadata
- Technical
- Educational
- Rights
- Relation
- Annotation
- Classification

³<http://www.ariadne-eu.org>

As a kind of an extension of LOM, the organization 'ADL - Advanced Distributed Learning Initiative' developed the 'SCORM - Sharable Content Object Reference Model'. It simplifies interchangeability, the general access and reusability of learning content for different learning environments.

3.4 Different Types of LMS

In Great Britain, they often referred to 'VLS' (Virtual Learning Environments) instead of LMS. Based on the reports of Britain und Liber (1999) and Milligan (1999) VLS are almost the same as the definition in Section 3, but the reports distinguish between following VLS:

- Traditional VLEs
- Extensions
- Learner centered
- Collaborative

Traditional VLEs are integrating extensions or collaborative methods, thus the division is not free of overlapping. The following Sections will discuss these kinds of Learning Management Systems in detail and is based on Schulmeister (2005) and Milligan (1999).

3.4.1 Traditional, Classic LMS

The structure is based on the classification principle: The course is divided in lessons, they contain several pages with exercises and exams. The design of this course units is top-down and the regular organization is serial.

A good example of a traditional VLE is 'Web Course Tools' (Figure 3.2). WebCT, or Blackboard Learning System, now owned by Blackboard (Jaschik, 2005). It provides a single environment for the delivery of learning material of learners and is used in many campuses for e-learning. It supports asynchronous and synchronous communications and instructors can add tools like discussion boards, mail systems or live chats, along with content including documents and web pages. Based on Hotrum (2005), WebCT was the world's first widely successful course management system with over 10 million students in its height.

3.4.2 Other Types of LMS

Alternative models of 'Learning Management Systems' have arisen, particularly at UK universities. These adopt a learner centered approach and provide a set of tools to allow the learner to construct an environment for effective learning. Examples for this kind of LMS is 'COSE'⁴ (Creating of Study Environments) and 'Learning Landscape'⁵.

For the type of an 'Extensions' VLE, 'CoMentor'⁶ is an example. It supports collaboration in synchronous and asynchronous way as well as an extension of the 'learner centered' model.

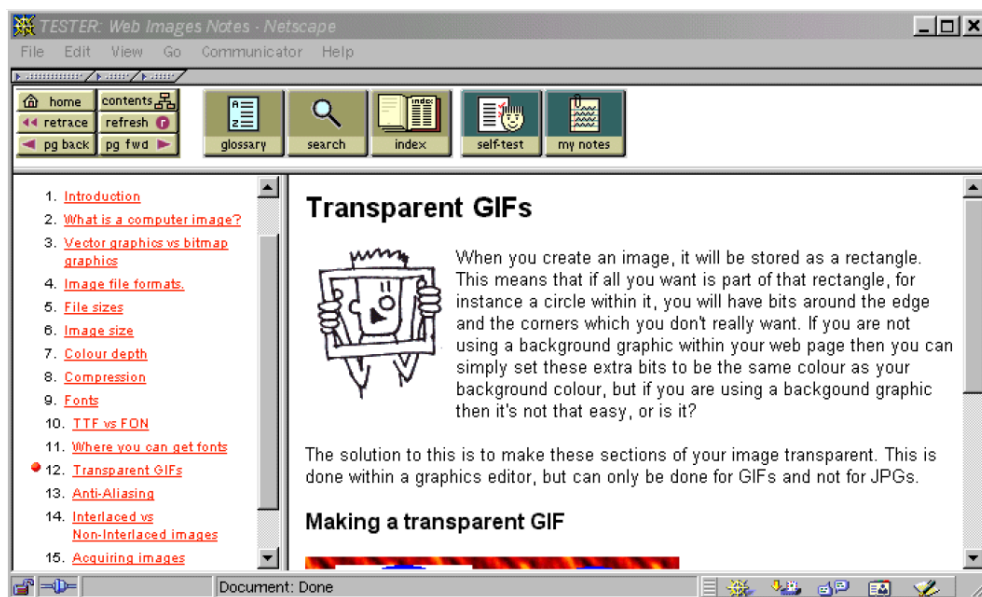


Figure 3.2: Example screen from WebCT, showing Linear Structure (Milligan, 1999)

3.5 Problems of LMS

At universities and schools e-Learning systems, like LMS, are almost as common as traditional classrooms, but offer additional materials for learning, like literature, discussion platforms or collaborative tools are still producing trials and

⁴<http://www.staffs.ac.uk/COSE>

⁵<http://www.learninglandscapes.ca>

⁶<http://comentor.hud.ac.uk>

tribulations. According to Sheehy, Ferguson und Clough (2008); Chittaro und Ranon (2007); Monahan, McArdle und Bertolotto (2008); Rose (2009), the following listing shows the most important disadvantages of e-Learning, particular Learning Management Systems.

3.5.1 Social Drawbacks

- *Lack of interactivity among people*
Often entering and exiting the students or teachers at different times. That makes it tough for the online learner to meet together. The face to face interaction that a classroom experience provides is missing. This can affect learner's level of motivation and cause feelings of isolation.
- *Miscommunication by Text Only Communication*
The main kind of communication between students and teachers are text based, like e-Mail, message board entries or instant messaging which contains a big risk of miscommunication. It could inhibit the communication flow if the answer needs several hours or days.
- *Technology issues*
Not every student or teacher is a professional user of e-Learning or LMS. Thus it can end in technophobia or that just the necessary software is not installed or supported.
- *Interface*
The offered interface has to be intuitive and easy. But insufficient instructions, uncommon navigation and sometimes unexperienced users can lead into problems.
- *Reduced social and cultural interaction*
The impersonality, suppression of communication mechanisms such as body language, and elimination of peer-to-peer learning that are part of this potential disadvantage lessen with advances in communications technologies.
- *Missing benefit*
Users are sometimes not able to appreciate the additional benefit of using e-Learning systems. That can head into disapproval of students or lecturers.
- *Reading ergonomics*
Because of better ergonomics reading, printed paper is preferred by many people.

All these points result in a lot of problems and misunderstandings in terms of e-Learning. Some of them can be improved through additional training or better introductions into the systems, but the lack of social contact and the motivation problems of students are able to lead to discrepancies. Also, missing feedback or support of technology problems may result in students' getting rid of Learning Management System. In summary, all these problems may merge into a very high 'drop out rate' of students.

3.5.2 Security Drawbacks

In addition to these issues, online applications always produce safety concerns, which will be discussed in the following points in detail. (Warren & Hutchinson, 2003; Sheehy et al., 2008)

- *Password*
A single default method is used to generate students' passwords. The problem is that the same simple method is used to generate thousands of students' logins. If the method of password creation were made public it would compromise thousands of passwords at the start of the semester.
- *Privacy*
If online systems contain personal data, like marks, test results or student records, privacy is one of the most important parts in this respect. The developers have to consider these issues to ensure data security as well as the user which have access to this private information.
- *Identity*
System with important data have to guarantee that the user is identified correctly. Not even the best identification system prevent students from switching places behind the computer, to cheat for an online exam.

3.6 Discussion

Schulmeister (2005) compared about 170 different Learning Management Systems in 2005. This study shows clearly how important and necessary supporting of web-based teaching has become.

After the beginnings of LMS, with multiple choice exams, in the present, LMS are part of education in general now. Main parts of LMS are: (i) user management, (ii) course management, (iii) role and rights, (iv) communication and presentation. Such systems support the teachers in their courses significantly and with the obvious advantages of Learning Management Systems, the easy providing of learning contents, the supporting of communication and the simplification of course administration, learning without the support of LMS, is no longer conceivable.

Unfortunately, there are disadvantages as well. It is not possible to get the social benefit of a personal meeting, which members of a face-to-face meeting automatically obtain. The teacher is not able to respond to weakness or questions immediately and the lack of facial expressions and gestures is difficult to replace. These disadvantages can be one reason for the high drop out rates of Learning Management Systems.

Thus, it is necessary to improve these drawbacks. One change to do that, can be the usage of Virtual Worlds in education. Virtual Worlds can imitate personal meetings very well and the opportunities of 3D open doors for presenting and demonstrating learning contents better than a simple website of a LMS or paper.

Chapter 4

Learning Environments in Virtual Worlds

As discussed in Section 3.3, Learning Management Systems have become a standard part of teaching and learning provision in further and higher education. These tools provide a wide range of features for supporting teaching and learning, from simple document sharing to enabling online discussions and assessments and integration with institutional information systems.

According to Chapter 2, multi-user virtual environments, like Second Life, which provides graphical spaces for social interaction, have moved to a main-stream hobby attracting millions.

Freitas (2008) show in their study, that already many educational applications got realized in Virtual Worlds. As a representative of the different types of examples, the following three applications got chosen.

Based on the study in Section 2.6, that Second Life is currently one of the most popular Virtual 3D World, the examples focus on this Virtual World.

4.1 Sloodle

'Simulation Linked Object Oriented Dynamic Learning Environment', or short 'Sloodle', is a free and Open Source project which integrates 'Moodle' in Second Life. (Sloodle, 2010)

4.1.1 Moodle

Moodle is an abbreviation for 'Modular Object Oriented Dynamic Learning Environment' and is the basic program of Sloodle. According to MoodleDocs (2010),

Moodle is a Learning Management System which offers following main features:

- Promotes a social constructionist pedagogy (collaboration, activities, critical reflection, etc).
- Suitable for 100% online classes as well as supplementing face-to-face learning.
- Simple, lightweight, efficient, compatible, low-tech browser interface.
- Easy to install on almost any platform that supports PHP. Requires only one database (and can share it).
- Full database abstraction supports all major brands of databases (except for initial table definition).
- Course listing shows descriptions for every course on the server, including accessibility to guests.
- Courses can be categorized and searched - one Moodle site can support thousands of courses.
- Emphasis on strong security throughout. Forms are all checked, data validated, cookies encrypted etc.
- Most text entry areas (resources, forum postings etc) can be edited using an embedded WYSIWYG HTML editor .

Currently around 50.000 sites, with 3.9 million courses in 210 different countries are registered on the Moodle statistic website. Thus, it is currently one of the most important LMS. (Moodle.org, 2010)

4.1.2 Features

To use the system of Moodle, Sloodle is integrating several features in-world. With this marriage of 3D and web-based technologies, the developer tries to widen more the adoption of virtual worlds as a tool for next generation Technology-Enhanced Learning. Based on Sloodle-Blog (2010), the following listing shows the currently implemented options of Sloodle:

- *Web-intercom*
A chat-room that brings Moodle chat room and Second Life chats together. Students can participate in chats in Second Life using the accessible Moodle chatroom. Discussions can be archived securely in a Moodle database.

- *Registration booth*
Identity management for Second Life and Moodle. Link students' avatars to their Moodle user accounts.
- *Quiz tool and 3D Drop Box*
Assess in Second Life – grade in Moodle. Set quizzes or 3D modelling tasks in an engaging 3D environment. Review grades quickly and easily in the standard Moodle gradebook.
- *Choice tool*
Allow students to vote (and see results) in Second Life as well as in Moodle.
- *Multi-function SLOODLE Toolbar*
Enhances the Second Life user interface. Use a range of classroom gestures, quickly get a list of the Moodle user names of the avatars around or write notes directly into to your Moodle blog from Second Life.
- *Presenter*
Quickly author Second Life presentations of slides and/or web-pages on Moodle. Present in Second Life without having to go through lengthy processes to convert or upload images.

These features got integrated in Second Life with the 'Linden Scripting Language'. As discussed in Section 2.10, Open Simulator supports almost all functions of LSL, thus Sloodle is already with the same features available in OpenSim. (Pirkola, 2009)

4.1.3 Technology

With the in-world programming language 'LSL', which includes different methods to communicate over the Internet with external services, like email, XML remote procedure calls (XML-RPC) or via HTTP-requests, Sloodle is communicating with external services.

The user is able to access Moodle with their Web-browser. Almost the same way is the in-world script of an Second-Life object using, when it tries to connect to Moodle. Via a HTTP request to a special module on the web-server, it gets data from Moodle (Figure 4.1). (Livingstone & Kemp, 2008)

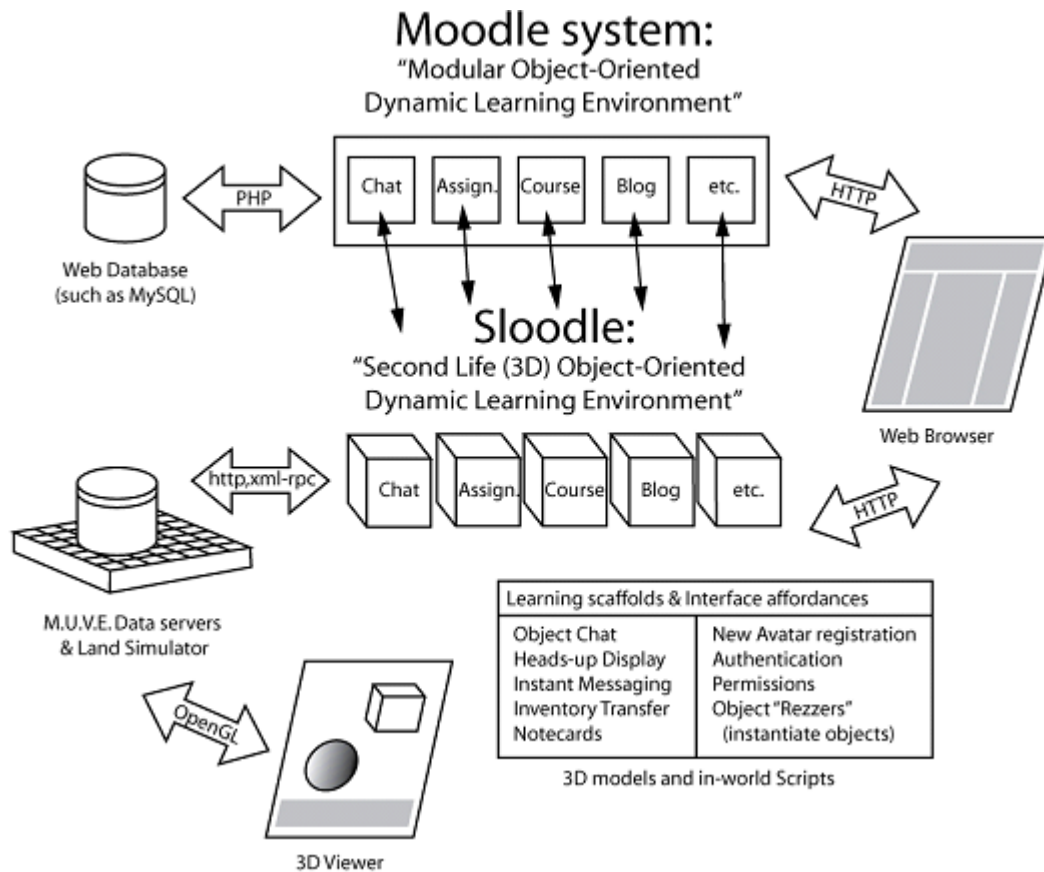


Figure 4.1: Architecture of Sloodle
(Livingstone & Kemp, 2008)

4.1.4 Educational Value

With the combination of Moodle and Second Life, Sloodle creates a flexible configuration of curriculum activities, contents storage, student tracking and course management, greatly enhances the management of students learning activities, while the main disadvantage is the lack of a realistic interactive social device.

"It has simple tools for creating objects, open-source language for creating interactions, data can be sent to web and areas of SL can be protected, etc. These features are helpful to improve students' learning enthusiasm". (Guomin & Jianxin, 2010)

This citation describes one of the important educational values of Sloodle. More benefits, based on Guomin und Jianxin (2010), are listed as followed:

- Inherit the modular System designing method, lower the technical threshold.
- Further strengthen the interaction, enrich the multimedia expressional form greatly.
- Provide a visualization identity management and improve the interface of learning environment.
- Support the creation of a virtual simulation environment, promote the cultivation of creative thinking of students.

4.2 Virtual Presence of TU Graz in Second Life

In 2009, the 'Graz University of Technology' developed a virtual presence, by Willkomm (2009). It contains several areas, like (i) Welcome Area (ii) Interactive Showrooms (iii) Testing Area - Sandbox (iv) Learning area with virtual lecture rooms (v) Meeting point for students (vi) Tutorials with communications- and multimedia tools and (vii) Event area.

In relation to the educational part, the following Section is focused on the interactivity of the area and the virtual lecture rooms.

4.2.1 Features



Figure 4.2: Welcome Cube at TU Graz Island
(Willkomm, 2009)

The area is focused on an interactive 'Welcome' cube (Figure 4.2), which is in charge to manage and set up the other parts of the project.

After choosing a virtual room, scripts are setting up the selected classroom, next to the 'Welcome' cube. Another press on the button teleports the avatar to the new room. Once in the new space, the user can select different furnishings, which get set up automatically (Figure 4.3 and Figure 4.4).



Figure 4.3: Menu to select furniture



Figure 4.4: Automatically created classroom

4.3 SciLands

The 'SciLand' project is a special area in Second Life where several organizations have docked their islands together (Figure 4.5) to create a virtual continent. Freitas (2008) describes in simple words the main tasks of the project.

"In general work falls into four main categories: research, learning and teaching, collaboration and public awareness. One Elon University Astronomy professor, for example, developed a planetarium in Second Life for his students to develop planetarium shows instead of written projects." (Freitas, 2008)

More examples of educational usage are provided by the 'US National Oceanic' and 'Atmospheric Administration (NOAA)'. They are hosting examples, like a 3D real-time weather map, a 3D submarine ride or a tsunami demonstration and they are using 'Sloodle' as a teaching tool as well. (SciLandsBlog, 2010)

Table 4.1 shows more examples of SciLand (Wikipedia, 2010). By the end of 2010, there were over 25 science and technology related organizations in the SciLands. This shows that already a lot of educational projects have entered into Second Life. In correlation to Section 2.7.3, generates these high costs for the rent of the SL-land. A open letter from the 'SciLands Senate' to Linden Lab (SciLandsSenate, 2010), discusses this problem. In particular, the authors are concerned about the omitting of the 'educational discount' in 2011, what Linden Lab scheduled.



Figure 4.5: Second Life SciLands Map
(Wikipedia, 2010)

Name	Sponsoring Organization	Description
NPR's Science Friday Victoria crater	NPR's Science Friday NASA	A weekly talk show on NPR covering a variety of science related topics. A one third scale model of Victoria crater found on the surface of Mars.
Real-time US weather map Hurricane Ride	NOAA NOAA	Observe the current weather above the continental U.S. Fly through a virtual hurricane aboard a P-3 Orion Hurricane Hunter.
Tsunami Demonstration Weather Balloon Ride	NOAA NOAA	See the deadly effects of a tsunami wave and learn how they are formed. Hold on to a balloon and learn about the instrumentation that NOAA uses to collect atmospheric data.
Submarine Ride	NOAA	Visit a variety of coral sanctuaries worldwide on board a virtual submersible.
Oil Spill Cleanup Demonstration	NOAA	Assist in the cleanup of an oil spill.
Red Tide Demonstration	NOAA	Understand the effects of a harmful algae bloom commonly known as red tide.
Sea Charting Demonstration	NOAA	Map the sea floor aboard a NOAA ship.
Science On A Sphere(TM)	NOAA	Visualize Earth data sets on a spherical projection screen.

Table 4.1: SciLands Examples
(Wikipedia, 2010)

4.4 Discussion

This Chapter shows three different projects in Second Life, with different strength and weaknesses.

The application 'Sloodle' is a perfect way to combine a Learning Management System, like 'Moodle', and a Virtual World. The deficits of LMS in communication and facial expressions get solved by the combination with Second Life. Conversely 'Sloodle' offers storage for documents and resources to fix this drawback of Virtual Worlds. Main disadvantage of this project is that it provides a set of educational tools, but it cannot create educational environments, like a lecture hall, or a office setting for a face-to-face meeting.

The project of the 'Virtual Presence of TU Graz' by Willkomm (2009) is not only a proper example of a good public appearance of an university, it shows also other usages in Second Life, with the flexible approach of creating a classroom if necessary. It shows that most of the objects in Second Life are placed on a static way. Especially educational material need not always be available. Unfortunately the project offers just one classroom situation. The tool creates a typical lecturer hall setting with a media presenter, a lecturer table and room for audience. But it would make much more sense if the setting could change to miscellaneous requirements and conditions. Particularly the educational field has different needs, such as collaboration settings, face-to-face setting and so on.

Regrettably the Island of TU Graz got closed by the end of 2010, because the 'Institute for Information Systems and Computer Media', which operates the platform, is changing to Open Simulator.

The third example - 'SciLand' is an area in SL devoted to science and technology. The resident organizations try to create a large continent with their individual regions. One main goal is to increase the visitor traffic and to make it easier to find useful educational content in-world. (Wikipedia, 2010)

It shows how well projects with an educational value can be implemented in SL. Sadly, the visitor traffic was not very good during the research for this Chapter. Also the open letter, about the increasing of the land fees from Linden Lab for educational organizations, shows that it would be much more efficient if the objects were just created on demand to reduce 'Second Life Land', which would result in automatic cost-savings.

In summary, all the discussed examples are specified in their way. Sloodle provides learning and teaching tools, SciLands presents different settings in an almost perfect way and the 'Virtual presence of TU Graz' creates learning space on-demand. But currently there is no project which combines everything in one tool.

Chapter 5

Project 'Second Life Room Manager'

The current generation of learners and teachers has to get used regularly to new systems or enhancements, like virtual reality or Learning Management Systems. But still this 'NET generation' or 'digital natives' must overcome several barriers to use educational tools in virtual worlds. Warburton (o. J.) summarized these barriers of using Second Life in higher education: (i) Technical (ii) Identity (iii) Culture (iv) Collaboration (v) Time (vi) Economic (vii) Standards (viii) Scaffolding persistence and social discovery.

Projects, like Sloodle or the 'virtual presence of TU Graz', try to reduce the complexity of educational applications in Second Life within the connection to external services and the producing of virtual classrooms on demand. But still these systems do not provide enough flexibility in order to meet various requirements. As Hornik et al. (2007) mentioned:

"... the technology should be flexible enough to adjust to multiple user's beliefs, as some users may not be able to adapt their preferred learning model to the one supported by the technology." (Hornik et al., 2007)

This Chapter will discuss the project called 'Second Life Room Manager'. This project is a prototype which provides a flexible learning environment in Second Life. It offers an eagle-eye view of special Second Life areas. Within these lands, the user can place Second Life objects via drag and drop wherever the user wants. It offers different kinds of objects, like special learning or collaboration tools and simple items like furniture or room layout objects. After finishing the desired setting, the user has the opportunity to send the setting to Second Life or save the setting for future use.

These opportunities and features are described in the following subsections. In particular, the development of the requirements, the implementation with findings and observed problems and in the end it shows screen shots of the usage of the tool.

5.1 Design

5.1.1 Project Idea

Aim of the project is the design and the creation of a prototype to manage different learning settings in Second Life via an external service. Independent of the technical, programming and Second Life skills, a user should be able to create various learning settings.

The work of Kopeinik (2010), serves as a previous project. It offers several collaboration buildings, a teachers' office and an outside recreation area (Figure 5.1). According to this work and Hornik et al. (2007), this project is not flexible enough. Thus, the idea is to provide at least those settings, but in a totally flexible way.

To define more needs of the environments, which should offer the project, it was necessary to do a survey on students and teachers which will be discussed in the following Section.

5.1.2 Online Survey

Design

Aim of the survey was to find the behavior of students in terms of learning patterns, in particular relating to e-Learning in virtual 3D-worlds, with specified questions about the behavior of students in context to group size, communication behavior, distance to the campus and previous experiences with 'Learning Management Systems' and 'Virtual 3D Worlds'. The questioning should strike out remarkable characteristics, like which Virtual 3D World is the most popular one. Also to support most of the learning situations, it was necessary, to ask students and lectures about their learning and teaching behavior. Another important area was the usage of collaboration tools.

It went online on the 15th of September 2009 via an special URL¹ with the Open-Source software 'LimeSurvey'². All detailed functions are listed at LimeSurvey

¹<http://www.freudenthaler.net/eLearningSurvey2009>

²<http://www.limesurvey.org/>



Figure 5.1: Collaborative Learning Setting
(Kopeinik, 2010)

(2010). It has been distributed via several different systems, more precisely the supervisors Uniz.-Doz. DI. Dr.techn. Christian Gütl and Dr. Vanessa Chang, and through different social platforms, like Facebook or studiVZ.

The survey contains 24 different questions and is split in three Sections. The complete survey is attached at the end of this document, see Appendix A.

At the beginning it starts with 'general questions', to get information about the proband, followed by questions about 'universal learning', to get a deeper insight on learning style and learning behavior. The last part asks questions about 'collaborative learning', in particular about the usage of platforms to work together on documents or how and how often the respondent interacts in groups.

Results

As mentioned the survey went online in the middle of September 2009. The URL had a rapid spreading and in about 15 days we got 333 responses, in particular 35 not completely filled out and 298 full responses, which is a great success for this short time and non-commercial distribution. All detailed replies are attached at the end of this document, see Appendix B.

Analysis

004 - <i>Are you a student or a lecturer</i> 13 % Lecturer 80 % Students
005 - <i>Do you have experience with 'Learning Management Systems'?</i> 40 % Yes 57 % No
006 - <i>Which LMS have you used before?</i> 26 % Moodle 15 % Blackboard
008 - <i>Do you have experience with virtual 3D worlds?</i> 38 % Yes 60 % No
011 - <i>Which virtual 3D world have you experienced?</i> 18 % Second Life 19 % World of Warcraft
018 - <i>Which communication medium do you prefer?</i> 58 % Synchronous communication 34 % Asynchronous communication
035 - <i>If you are working in learning groups, what was your most useful learning mode?</i> 42 % Brainstorm together 16 % Create a document together 50 % Discuss about lecture/seminar/lesson 21 % Learning by teaching (prepare a presentation, ...)

Table 5.1: Result of the Online Survey

The answers give an interesting overview about learning and collaborative work from students or lecturers. Table 5.1 shows the significant analysis in detail.

The respondent were mostly male students from Europe aged 25 years and older. Furthermore, about two-thirds were students who lived within 10km of the campus. 40% had experiences with LMS, more precisely 26% already used 'Moodle' or 15% tried Blackboard. This result correlates with the literature study from Chapter 3. Slightly less (38%) have already been online in Virtual 3D Worlds. But just as in Chapter 2, Second Life and World of Warcraft are the most popular platforms in this survey. By the fact that 58% prefer 'synchronous communication', Virtual Worlds will have a good chance of being popular in future.

Findings

As a result of the survey, the prototype has to fulfill following points:

- *Usage of Second Life*
SL is the most popular Virtual World with the possibilities of programming and scripting.
- *Easy and simple*
The prototype should be self explanatory in order to simplify the entry into Second Life for unexperienced user.
- *Supporting of every learning situation*
The new tool has to support as many different learning situations as possible, which results in the decision that the prototype has to be as flexible as possible in this context.
- *No out stabbing trend in learning tools*
The survey showed no special trend in learning tools. Thus the prototype should support all available e-Learning tools at Second Life.

This findings agree with previous research, like the usage of SL or that the project should be as flexible as possible. These approaches were incorporated into the requirements, which will be discussed in the following Section.

5.1.3 Requirements

Through brainstorming about the result of the survey and the findings in literature, the developer and the supervisor of this project defined the requirements. It was defined that the tools should be as easy as possible, should support almost all learning situations with all available Second Life e-Learning tools in a self explanatory way. A student or tutor should be able to plan their learning setting in their own way, with their preferred equipment. To allow a reuse of the designed learning environments, the tool should provide to save, reload and adapt scenarios. These drafted settings should get realized in Second Life automatically without any interaction of a SL-avatar.

To list this requirements in detail, it was necessary to split the project in two parts, the off-world application and the Second Life part. The acquired points have been listed in the following tables. Table 5.2 shows the necessary implementations of the external, not in-world, part of the project. The other segment, the in-world unit, has to realize the prepared settings from the external service in Second Life and is listed in Table 5.3.

Special attention is paid on the examination if this project is feasible, because the expectation of restrictions and limitations with the communication and the scripting possibilities in-world are present. Thus it was decided to develop a first prototype to see if the idea is realizable.

<i>Create and reuse various learning scenarios</i>
The main task is the general possibility to manage and reuse different learning setting.
<i>Provide an eagle eye view of learning scenarios</i>
The project should give a top view of the applicable area in the Virtual World to create different learning environments in detail.
<i>Simple and self-explanatory</i>
The tool has to be intuitive and increase the courage of the usage for students and teachers.
<i>Manage different areas</i>
To support different located places in the Virtual World the developed application should be able to manage this.
<i>Save and reload scenarios</i>
After the user sets up a new learning setting in the eagle eye view it has to be possible to save this scenario and reload it at another time.
<i>Manage user access to prepare scenario</i>
If the users in the Virtual Worlds want to get privacy in a learning environment it should be feasible to control the access.
<i>Associate time periods to learning settings</i>
Prepared learning scenarios have to be associated to specific time points where the setting gets realized and deleted automatically.
<i>Show scenario status and attendant avatar status</i>
To get a feedback from the Virtual World, it should send the status of the transposing setting and avatar which are using it back to the tool.

Table 5.2: Requirements off-world

<i>Check periodically on transposing learning environments</i>
In the in-world part it has to check on a regular period if the external service sends data about prepared scenarios.
<i>Implementation of the received data</i>
The received data get realized in-world as placed and attached in the eagle eye view in the external application.
<i>Delete the realized data</i>
The implemented items get deleted after the usage
<i>Send scenario and avatar status</i>
To get a feedback of the in-world implementation and interactions to external part, it should send the scenario and avatar status.

Table 5.3: Requirements in-world

5.1.4 Second Life in Detail

User Interface

A single free download of the client program, followed by its installation, is necessary to get Second Life started. If a new user will be logged in, the avatar will be placed on an orientation island, to fulfill easy instruction tutorials to get used to the interface. The interface contains different bars (Figure 5.2). The following Figures 5.3, 5.4 and 5.5 show these bars in detail and are based on SecondLifeWiki (2010g).

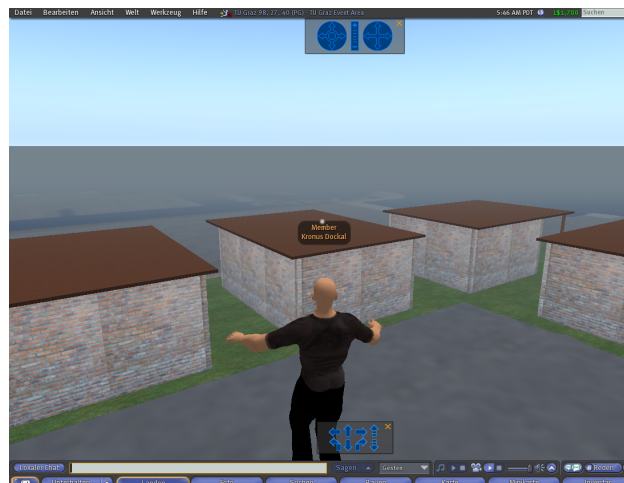


Figure 5.2: Second Life User Interface

Top Bar

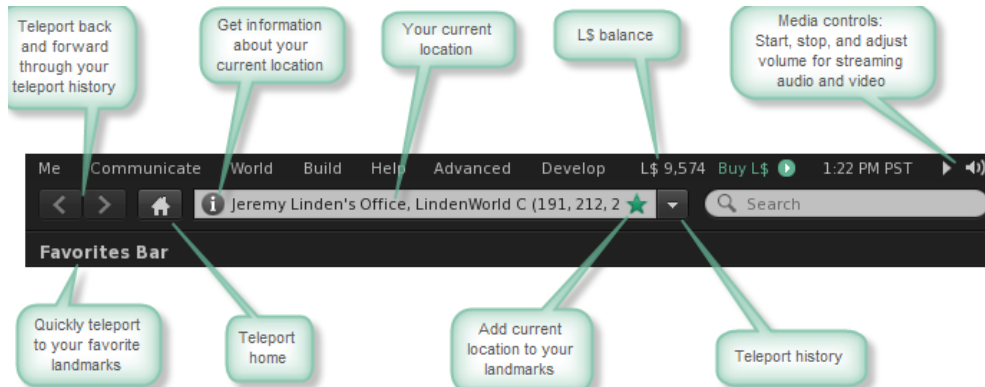


Figure 5.3: Second Life Interface Top Bar
(SecondLifeWiki, 2010g)

To access most of the features, tools, and options in the Second Life Viewer, the user gets comfortable with finding his way around the menu bar at the top of the screen and the task panel bar at the bottom of the screen.

Bottom Bar

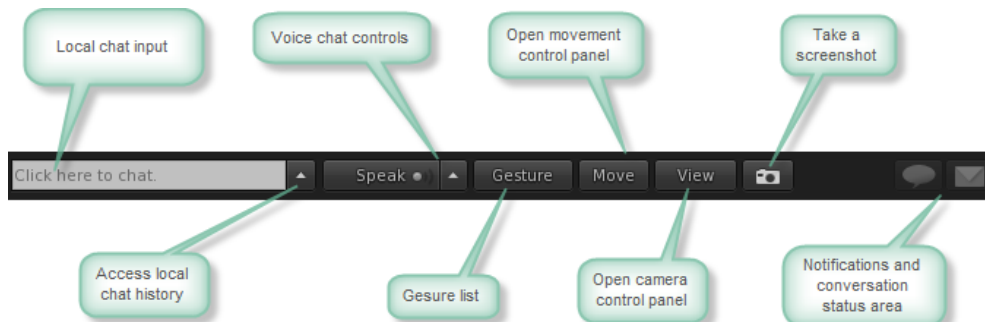


Figure 5.4: Second Life Interface Bottom Bar
(SecondLifeWiki, 2010g)

Side Bar



Figure 5.5: Second Life Interface Side Bar
(SecondLifeWiki, 2010g)

The sidebar is a multi-functional display that contains many useful tools for customizing an avatar, exploring the world, and learning about the surroundings. There are many more menus or bars to control and interact in Second Life. But it would go beyond this research to describe all of them. The last really important menu is the option to create prims.

Primitive

SecondLifeWiki (2010e) explains a 'prim' as followed: *"A primitive, or prim, is a single-part object. Multi-part objects will have multiple parts ('prims')."*

In Second Life, every virtual object, like a car, house, clothes or even hair is made of one or more prims. Usually they got created in-world with the built-in object editing tool. (SecondLifeWiki, 2010e)

As Figure 5.6 shows, there are eight different primitive shape types.

Each prim is represented by several parameter (SecondLifeWiki, 2010e), like

shape/type, position, scale/size, rotation, cut, hollow, twist, shear, color, texture, bumpiness, shininess and transparency.

To create more difficult things, it is possible to link prims together. Very important with linked prims is that the last selected prim is the 'Root Prim'. This prim defines the name and position of the whole combined product. (SecondLifeWiki, 2010b)



Figure 5.6: Different primitive shape types
(SecondLifeWiki, 2010e)

Scripting Language

Attending to SecondLifeWiki (2010a), 'LSL', Linden Scripting Language is the programming language in Second Life. It enables to control the behavior of every single prims but not in an avatar. Thus, it provides a lot of possibilities to change the environment of Second Life via a script. The syntax is similar to JAVA and C. The language is based on 'States' and 'Events'. A door can be 'open' or 'closed'. Listing 5.1 shows the standard code for every new script.

```
default
{
    state_entry ()
    {
        llSay (0, "Hello , Avatar!");
    }

    touch_start (integer total_number)
    {
        llSay (0, "Touched.");
    }
}
```

Listing 5.1: "LSL Standard Script"

Further details, problems, lags and descriptions of severals commands, can be found in Cox und Crowther (2009) and Henke (2007).

Communication between SL and outside

Method	Who initiates communication	Message length	Execution delay
E-Mail	Anyone (script / external system)	4096 chars	20 seconds
XML-RPC	External service	254 chars	3 seconds
HTTP request	LSL script	2048 chars	None

Table 5.4: Communication methods in Second Life
(Valerio et al., 2009)

As defined in Section 5.1.3, the prototype will be realized within an external service. Thus it is necessary to take a look at the opportunities to communicate between Second Life and the 'external world'.

According to Valerio et al. (2009); Jia (2007); SecondLifeWiki (2009a), there are three different methods to exchange data with an external institution: (i) sending and receiving emails; (ii) responding to external calls by means of a remote procedure call mechanism (XML-RPC); (iii) message exchange using the 'Hyper Text Transfer Protocol' (HTTP). The features are summarized in Table 5.4. Furthermore, it is necessary to compare these communication methods in detail.

(i) E-Mail (Figure 5.7): It is possible to send an e-Mail via a LSL-script to every address. The return address gets generated via the 'ObjectID' of the script contained object (`objectId@sl.secondlife.com`), to respond later. This service includes information such as the object name and its location in-world in the email message body.

(ii) Valerio et al. (2009) describes the second method (Figure 5.8) followed: *"[...] XML-RPC, is provided by a dedicated server in the server grid of the SL world. An external system can use it to invoke a script in SL, using HTTP protocol and XML-encoded messages, as long as the script has previously opened a channel for message reception."*

Unfortunately, this method has several disadvantages. As already shown in Table 5.4, it has a delay and the shortest Message length. But besides that there is a scalability issue due the existence of only one server in the SL world to process all such communications and it buffers only one message per destination channel, which aims in the unpleasant behavior that the external system must serialize message sending. This makes XML-RPC in SL inadequate for high-throughput or other applications with external services.

(iii) The last method (Figure 5.9) to get contact to an external server is via HTTP requests. As mentioned in Table 5.4 this communication way has no delay, an acceptable message length of 2048 chars and must be initiated by an SL script.

SL servers do not hinder HTTP requests in terms of communication speed which is an advantage as well.

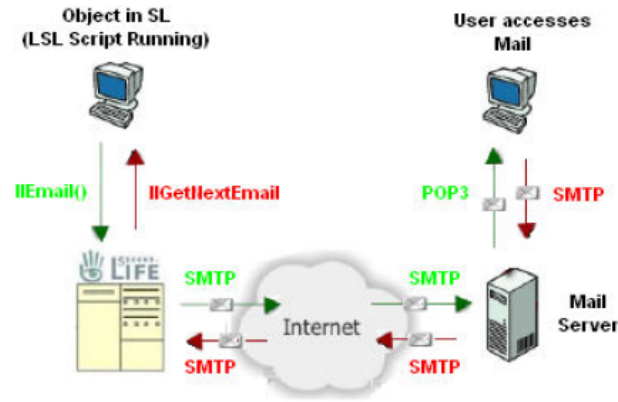


Figure 5.7: E-Mail communication
(Valerio et al., 2009)

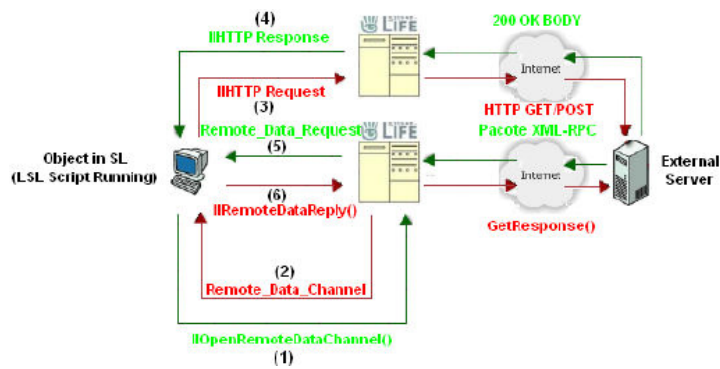


Figure 5.8: XML-RPC communication
(Valerio et al., 2009)



Figure 5.9: HTTP-Request communication
(Valerio et al., 2009)

5.2 Development

The following Sections describe the first prototype of the 'SLRoomManager' in detail. In particular, the partitions of the project and its elements are shown. At the end of this Chapter, screen shots of the usage will be presented.

As mentioned in Section 1.1, the development started at Curtin University of Technology of the prototype and the first successful implementation was tested, in Australia. The final realization of the requirements got finished at the Graz University of Technology in Austria. A presentation of the project and its usage was recorded and was published together with several videos at the 'YouTube' Platform³⁴. Several parts of the following subsections has already been published in a paper on a conference in Belgium. (Gütl, Chang & Freudenthaler, 2010)

The whole project, like source code, screen shots, videos, etc., is attached to this document via a CD-ROM in Appendix D.

5.2.1 Partition Web - SL

In correlation to Section 5.1.3 the project is split in two parts (Figure 5.10), the 'Off-world' and the 'Second Life' part.

(i) The 'Off-world' realizes the requirements from Table 5.2. It was decided that the 'User Interface' create an 'eagle eye view' from a defined area in Second Life, through a web application because it is already necessary to be online to transfer data into 'Second Life'. Similarly, the advantage that no program needs to be installed, just visit a website instead, facilitates the usage.

(ii) On the in-world side (Second Life), an implementation to handle the provided data, according to Table 5.3, is essential. The idea is to have a centered item which checks periodically if new data are offered.

It must be noted, that the project is a prototype. Especially the 'off-world' part got realized as proof of the concept. In an advanced version, the 'Backend Interface' would be running on the same web-platform like GWT.

More details on the various implementations are described in the following Chapter.

³<http://www.youtube.com/user/SLRoomManager>

⁴<http://www.youtube.com/watch?v=u-f3islIHDQ&hd=1>

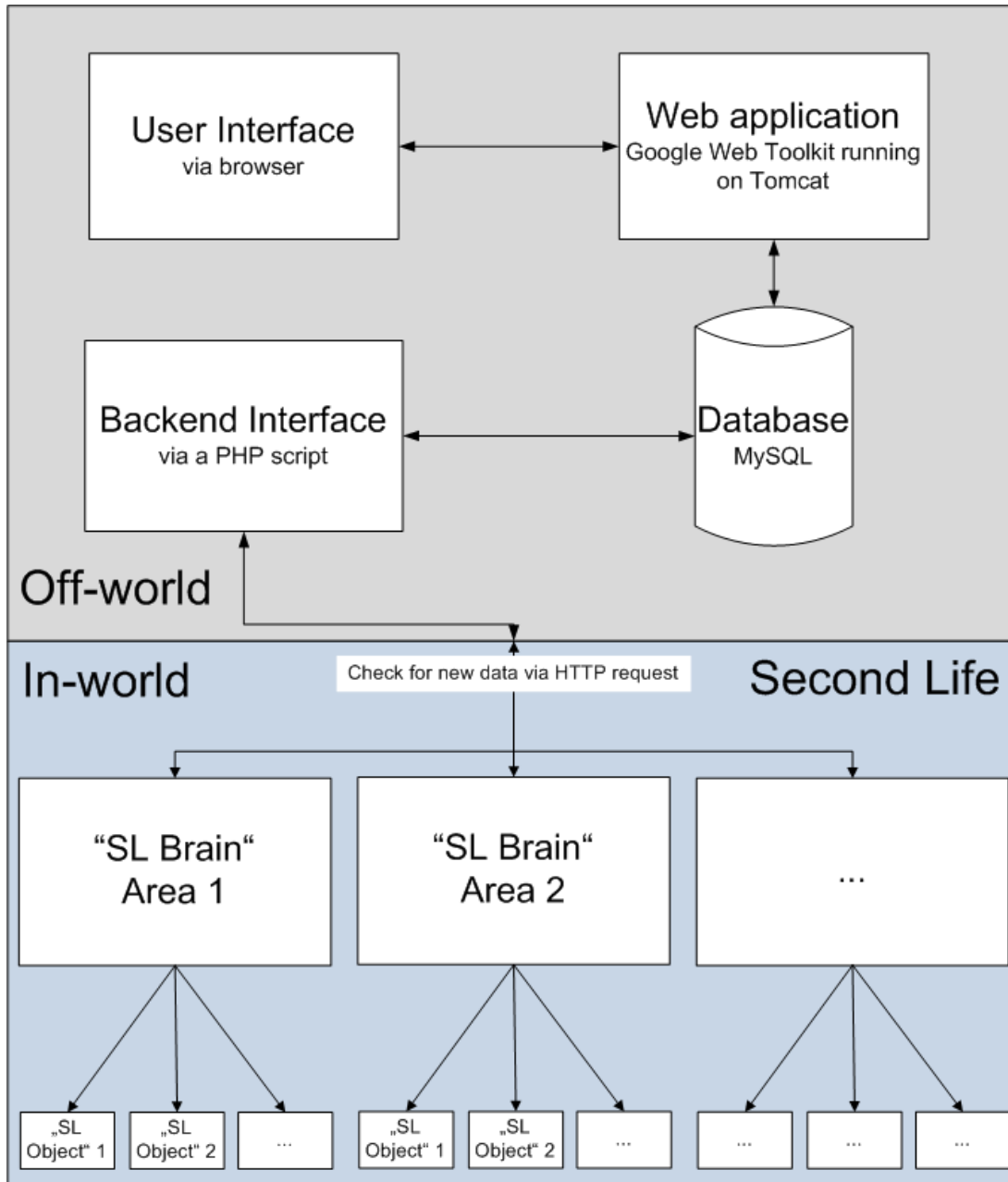


Figure 5.10: Conceptual Architecture

5.2.2 Used Software

The 'SLRoomManager' uses various types of software. The following Chapters will discuss the chosen software in detail.

Google Web Toolkit

The 'graphical user interface' application got developed with 'Google Web Toolkit'⁵ in version 2.0.3. GWT is running on an 'Apache Tomcat'⁶ server. Eclipse was chosen as editor. GWT is an open source set of tools that allows web developers to create and maintain complex JavaScript front-end applications in Java (Google, 2010).

Slender (2009) lists the most important features of GWT as follows: (i) GWT completely supports version 5 of Java (ii) The Java-to-JavaScript compiler including a hosted mode simulation for full debugging (iii) Completely browser independent (iv) Variety of server communication such as JSON, RPC and XML (v) Support of the basic widgets (vi) Browser independency (vii) Support of 'JUnit tests' and international languages.

The main reason to use GWT was the possibility to use asynchronous remote procedure calls (RPC) and the availability of 'Drag and Drop' widgets.

More Software

The 'Online - Database' is realized as a simple 'MySQL' database in the version 5.1. Main reason for the usage of MySQL is the previous knowledge of the developer and the simple manageability of MySQL.

The 'Backend Interface' is a simple PHP script running on an Apache HTTP server. Main task of this part is an easy access to the 'Database'. PHP offers this in a simple and fast way.

The complete project got developed in the first Version of the 'Second life Viewer'. In the middle of the year 2010 the new version 2 got released. The new version offers more opportunities for the 'SLRoomManager', but the project has not been adapted to them.

⁵<http://code.google.com/webtoolkit>

⁶<http://tomcat.apache.org/>

5.2.3 Off-world

The 'off-world' part is split in three modules, 'User Interface', 'Database' and 'Backend Interface', itself (Figure 5.10) and will be discussed in this Section in detail.

User Interface

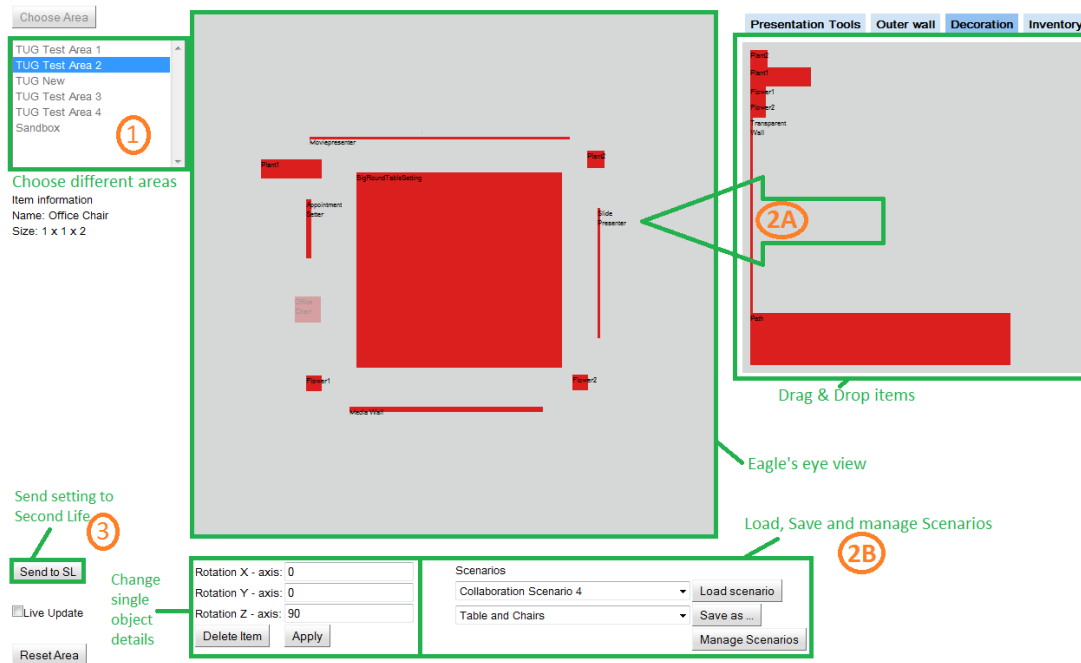


Figure 5.11: Graphical User Interface

The main component of this project is the 'User Interface' to manage learning settings. To achieve the given premises the 'Graphical User Interface' (Figure 5.11) got developed. Currently between the geometric dimension form the SL-Areas and the available SL-Items stored in the 'SL-Brain' is a conversion factor of 30, which means that one meter in Second Life is 30 pixel at the 'SLRoom-Manager'.

The application is a 'Web-application' which is accessible with every common web browser, like Internet Explorer or Mozilla Firefox. The used software is 'Google Web Toolkit'.

The orange-colored numbers help to explain the different parts.

The following listing describes a typical procedure of an user when using the 'SLRoomManager':

(1) *Choose an Area*

At the beginning the user has to choose an area which he wants to work with. The areas are different in size and location in Second Life.

(2A) *Place Items*

After the eagle eye view is created in the center of the software, the user can place several red-colored items into the gray area. All available objects are sorted into different categories. Currently four different classes are distributed (Presentation Tools, Outer Wall, Decoration, Inventory)

(2B) *Load, Save manage Scenarios*

It enables the opportunity to load or save created settings. A loaded scenario will be placed again in the eagle eye view and can be changed or extended with more items.

(3) *Send to SL*

After loading or creating a new scenario, the user has to press the button 'Send to SL'. Therewith the application converts the placed items into Second Life useful coordinates and transfers them into the database.

In addition to this procedure, the following list and Figure 5.12 and Figure 5.13 describe more providing features of the tool:

- If a drag-able red-colored item is in use, extra information, like the 'Name' or the 'Size', pop up under the 'Area-Box'.
- Separately, if a red-colored item in the eagle-eye-view is in focus, an additional area to delete or rotate the item shows up.
- The button 'Reset Area' resets everything to the initial situation after choosing an area. This means, all placed items in the main area get deleted and if the data got already transfer into Second Life, a 'Delete-Command' will be sent.
- The check-box 'Live Update' is an optional feature which replaces the button 'Send to SL'. It transfers any change in the eagle-eye-view immediately and automatically into Second Life.

Assign Timeslot to Scenario Sandbox

Sun	Mon	Tue	Wed	Thu	Fri	Sat
					1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30

Start time: End time: Scenario:
 15:00 15:30 CollaborationSetting1

Selected date: 30.10.2010
 IDFROMTO Scenario

Assign TimeSlot to Scenario ...

Close

Figure 5.12: Feature time slots

Figure 5.11 shows the button 'Manage Scenarios'. This feature gives the opportunity to assign saved scenarios to time slots and limits the access for certain Second Life users. As Figure 5.12 shows in detail, the user has to select a date, time period and the previously created scenario and the application creates all necessary commands with the chosen time stamps and stores them in the database. In addition, it is possible to register Second Life avatars which are allowed to join the scenario. Figure 5.13 displays this feature. It is necessary to add the first and last names of the avatars. If someone is willing to attend the scenario, it checks whether the user is registered in the database and enables the access.

Selected date: 30.10.2010

ID FROMTO	Scenario
2622:15 22:30	Office Setting 2
2722:30 23:0	Office Setting 2

Insert Second Life Account Names:

Frist Name	Last Name
Kronus	Dockal
Gu	New Last Name

Delete User
Add User

Assign TimeSlot to Scenario ...

Figure 5.13: Feature access control

Database

The second part of the 'Off-world' is the 'Database'. It is accessible from the 'User Interface' and from the 'Backend Interface'. The following listing shows the main parts of the database. Figure 5.15 shows the schema of the database in detail.

- Store information, like 'Name', 'Size', 'Type', 'Rotation' and more, about every Second Life item which is employable with this prototype (Figure 5.15 Table 'tslitems').
- Store information, like 'Name', 'Location', 'Size', 'SUrl', and more, about every available area which is prepared for the 'SLRoomManager' (Figure 5.15 Table 'tarea').
- Store actual scenarios, their items, coordinations, and more.
- Store data about prepared scenarios, like time slots or users.

Backend Interface

The last part is the connection between 'Second Life' and the 'Off-world part'. Unfortunately, LSL does not provide an opportunity to connect directly from SL to the database. Thus the inception of this interface is necessary.

Activated by an SL script, it connects to the database and answers with the requested information. Figure 5.14, shows an example of a response. Every single line is a command with separate information, like 'Unique ID', 'Name' and so on stored in the database. Further information can be found in Section 5.2.4.

According to Figure 5.15, all commands are stored in 'Table tslcommands'. There are more information displayed than Figure 5.14 shows. The entry 'tC_done' is a flag with the task to illustrate the undone commands. After the 'Backend Interface' forwarded these undone orders, the 'SL-Brain' sends an acknowledge message and the 'tC_done' will be marked to 'done'.

Another important task of the 'Backend Interface' is to check the time stamps of the commands. If a user assigns a time slot to a prepared scenario, the 'SLRoomManager' immediately creates all necessary commands. All of them get tagged with the proper time stamp. For example, a 'CREATE' command is tagged with '20102212-22:30' and a 'DELETE' command with '20102212-23:00'. Thus, the 'Backend Interface' checks the time stamps and forwards only actual commands. Other commands, which should get realized immediately, always contain the current time.

Figure 5.15 shows the current database schema. The tables are already prepared for advanced usage (tagged with character '*') to save more information for further versions. In addition, the following entries are important and must be considered in detail:

- *tScTi_starttime and tScTi_endtime in tscenario_times*
These table entries show the start and end time stamp of an assigned scenario, which are tagged to the regarding commands.
- *tC_done, tC_extra and tC_ID in tslcommands*
tC_done is just a flag with shows if the command is already done or not.
tC_extra contains the size of the area for the command 'CREATEWALL'.
tC_ID stores the channel ID for the in-world communication of the SL-Brain.
- *tSLI_Multi in tslitems*
tSLI Multi indicates when an element is frequently or only once available per area.

5.2.4 SL Realization



Figure 5.16: SL Realization of 5.11

Figure 5.16 shows the realized setting created from the 'SLRoomManager', according to Figure 5.11.

As mentioned in Figure 5.10, there is a partition on the Second Life side necessary. For every area in-world, which the 'SLRoomManager' should control, a centered control unit is necessary. It got named 'SL-Brain'. The 'SLRoomManager' can manage areas on different islands, that is the reason, why every area needs its own 'SL-Brain', because a script can not interact on several sims.

The color of the 'SL-Brain' shows the status. 'Red-colored' means the script is stopped, 'Green-colored' shows that the LSL-script runs in an infinite loop (Figure 5.17 and Figure 5.18). It is not necessary, for a Second Life user to start the SL-Brain, the colors just help the developer to debug if problems happen, similarly the text lines above the brain. They show the last received commands from the 'Backend End Interface'. The 'SL-Brain' is realized as a simple standard



Figure 5.17: SL-Brain during receiving data in Second Life

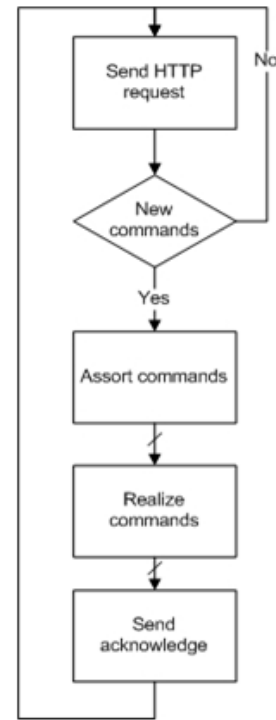


Figure 5.18: SL-Brain procedure

cube (Figure 5.17) in Second Life. The important part is the LSL script in the prim, not the outward appearance.

The script as shown in Figure 5.18 runs in an infinite loop. A 'HTTP request' is sent regularly to the 'Backend interface' of the 'Off-world'. It is necessary to wait a certain time between each passes because Second Life limits the amount of connections to external servers. After receiving several commands, the script assorts the different orders. As mentioned in Figure 5.14, each command is in a single line. The specific data is divided with the character '|'. After parsing all received data (Figure 5.18 'Assort commands'), the commands get executed or forwarded. (Figure 5.18 'Realize commands')

Currently the following commands are executed by the SL Brain:

- CREATE
- CREATE WALL

If the 'SL Brain' receives a CREATE command, the dependent Second Life object

(every item of a learning setting is created this way) will be 'rezzed' next to the 'SL Brain'. Rezzing is the LSL command for creating an object. To use this function, it must be kept from the root object in the inventory. An important part during this phase is that the 'SL Brain' will hand-over a unique ID, which it receives from the GUI and is unique in Second Life and in the web application. Figure 5.14 shows the parameter to create an object. This ID will be the channel where the new Second Life object can 'listen' for more commands from the 'SL Brain'. In Second Life, LSL scripts are able to communicate with each other via the 'listen' command (SecondLifeWiki, 2009b). This method requires a channel to 'listen' to other messages from other LSL scripts. Thus, the unique ID supports every item of the environment setting by receiving its own commands from the 'SL Brain'. The CREATE WALL command creates the basic structure of the learning setting, such as walls, floor and roof. These components consist of several single components, because Second Life limits the size of a single object to 10 meters in width, height and length. Therefore, the 'SL Brain' has to move to the position before it 'rezzes' the single objects. The reason for this is that objects can only be rezzed up to a radius of 10 meters away from the root object.

All other Second Life objects, except the 'SL Brain' of this project, have to obtain a special LSL script included. Otherwise it cannot be controlled by the 'SL Brain'. This script is responsible to execute the following commands, which have been forwarded from the 'SL Brain':

- MOVE
- ROTATE
- DELETE

After assorting and executing or forwarding the received data, the 'SL-Brain' sends an 'acknowledge command' to the 'Backend Interface'. This procedure contains the 'continuous ID' of the commands and the specific 'Area ID', compare Figure 5.15. The 'Backend Interface' marks all commands as 'done' in the database, thus these instruction will get ignored by the next 'HTTP-request' of the 'SL-Brain' (Figure 5.18 'Send acknowledge').

Figure 5.19 shows the flow of data between the 'User Interface', the 'Background Interface', the 'SL Brain' and a Second Life object in detail.

A further important step in this project, according to the SL-Brain, has to get explained in detail, if another object should get included into the application.

Expand SL-Brain Inventory

As mentioned in Section 5.2.4, it is essential that every Second Life object which wants to be controlled by the 'SL-Brain', has to contain a prepared LSL-script. Without that special script, it is not possible to communicate between the brain and the object. Following points are also necessary to integrate a new object:

- Contain prepared LSL script.
- Input of the data, like geometric dimensions, name, and more in the database (Figure 5.15; Table 'tslitems').
- It must be possible to multiply the object.
- It must be part of all 'SL-Brains' inventories.
- The name of the item has to be unique, because the items will be 'rezzed' by their name from the 'SL-Brain' inventory.

These steps must be done to get a new object integrated into the 'SLRoomManager'. One problem contains the Second Life market place where it is possible to buy prims from other users. Each offered object can have different rights in terms of reselling and modifying. It is indispensable that the new object offers the rights to integrate the prepared LSL-script. Otherwise it cannot be used with the 'SLRoomManager'.

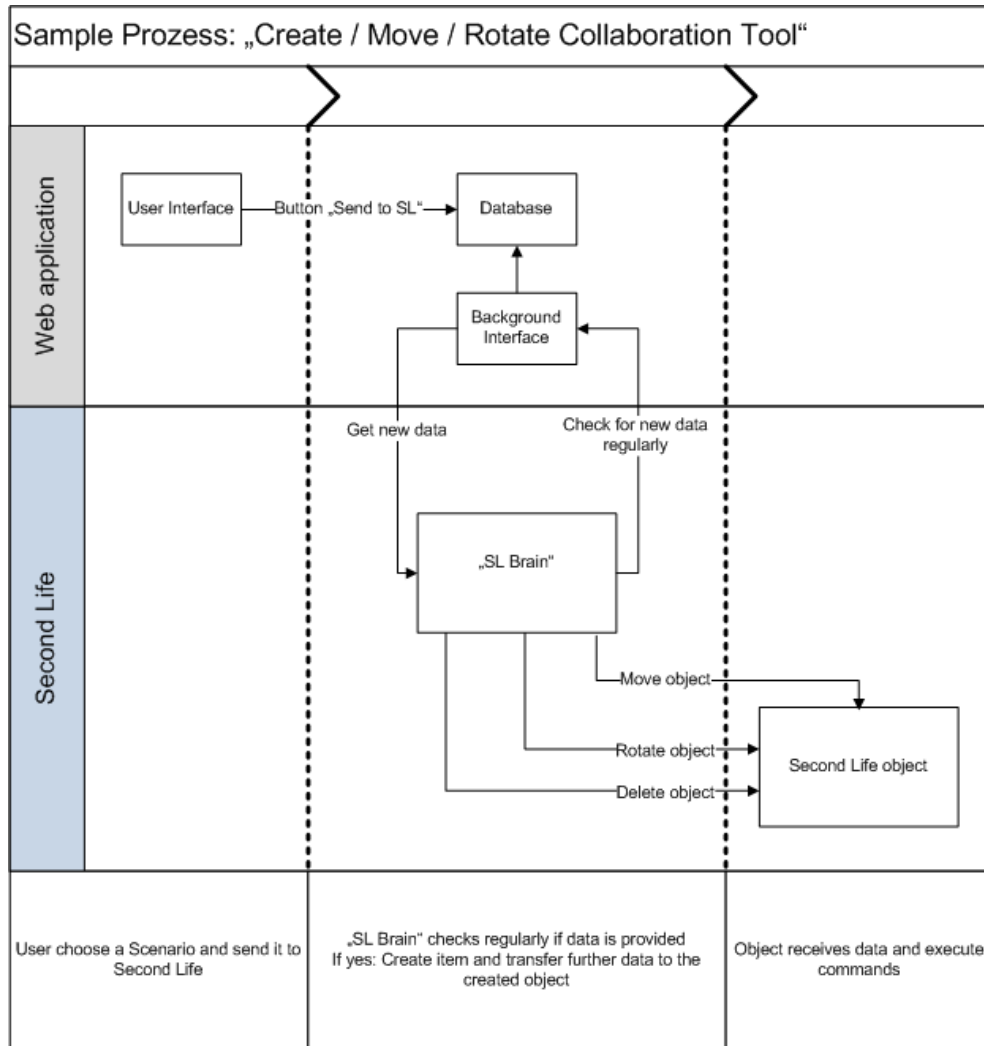


Figure 5.19: Sample sequence

Technical aspects

This project, especially the Second Life part, contains special refinements and technical implementations, which are not obvious at first glance. The following points will help to continue the project in another thesis or paper:

Access Control

As mentioned is it possible to limit the access to the specified areas with the 'SLRoomManager'. Currently this limitation is not processed by the SL-Brain. As visible in Figure 5.20, all areas are covert with an almost invisible wall.

This wall communicates via the 'Backend Interface' on-demand. It verifies if an entering avatar has the right to join the SL-Area at that time. In future, this part should be realized by the SL-Brain. Since the island which was used for this development, was closed at short notice, this fast method has been implemented.

Unique IDs

Every available item in the 'SLRoomManager' obtains a unique ID as soon as a user presses the button 'Send to SL' or a time slot is assigned to a scenario. This ID is necessary as the channel ID for the communication between the 'SL-Brain' and the corresponding item. This item listens to this channel to receive new commands. This channel ID is an 32 bit integer data type in Second Life, which means it can be between -2.147.483.648 and +2.147.483.647. (SecondLifeWiki, 2009b, 2010c)

The method 'rezzing' in the 'Linden Script Language' needs a unique name of object the to be created. With this name the object is stored in the 'SL-Brains' inventories. Thus, it is necessary to store this unique name in the database as well. (SecondLifeWiki, 2009b)

Rights for the SL-Brain

To run the complete project, in particular the 'SL-Brain', following points have to be guaranteed:

- General access to the Second Life land.
- It must be allowed to run LSL-scripts.
- It must be possible to 'rez' objects.
- If the 'SLRoomManager' contains tools, with foreign scripts, which have another owner, it is necessary to allow these LSL-scripts.

5.3 Usage

This Section describes a typical usage of the 'SLRoomManager' in detail. As an example the biggest area in Second Life has been chosen. The following screen shots shows the single steps from loading a prepared scenario till it gets finished in Second Life. The sequence lists the following enumeration:

1. At the beginning, the SL-Areas are empty and the respective SL-Brains are waiting for work. *Figure 5.20*
2. The scenario is prepared and ready to get realized in Second Life. After the user has pressed the button 'Send to SL', the data will be sent to the database. *Figure 5.21*
3. After choosing the right scenario, the user can assign it with a time slot. Thus it gets created and deleted at the given time. *Figure 5.22*
4. Another features is that it is possible to limit the access for specific Second Life users. *Figure 5.23*
5. The 'SL-Brain' with the single items are created. *Figure 5.24 and 5.25*
6. After the 'SL-Brain' has created all the necessary items, it receives the 'MOVE-Commands'. They will be forwarded to the respective SL-object and they are moving themselves to the intended position. *Figure 5.26*
7. After all objects have been created, have received their 'MOVE-Commands' and have moved to the intended position, the SL-Brain creates the outside wall of the area. *Figure 5.27*
8. At the end the 'SL-Brain' moves back to the start position and waits for further data from the external application. *Figure 5.28*
9. Through the limitation for specific Second Life users, other avatars get blocked to enter the area with the prepared setting. *Figure 5.29*

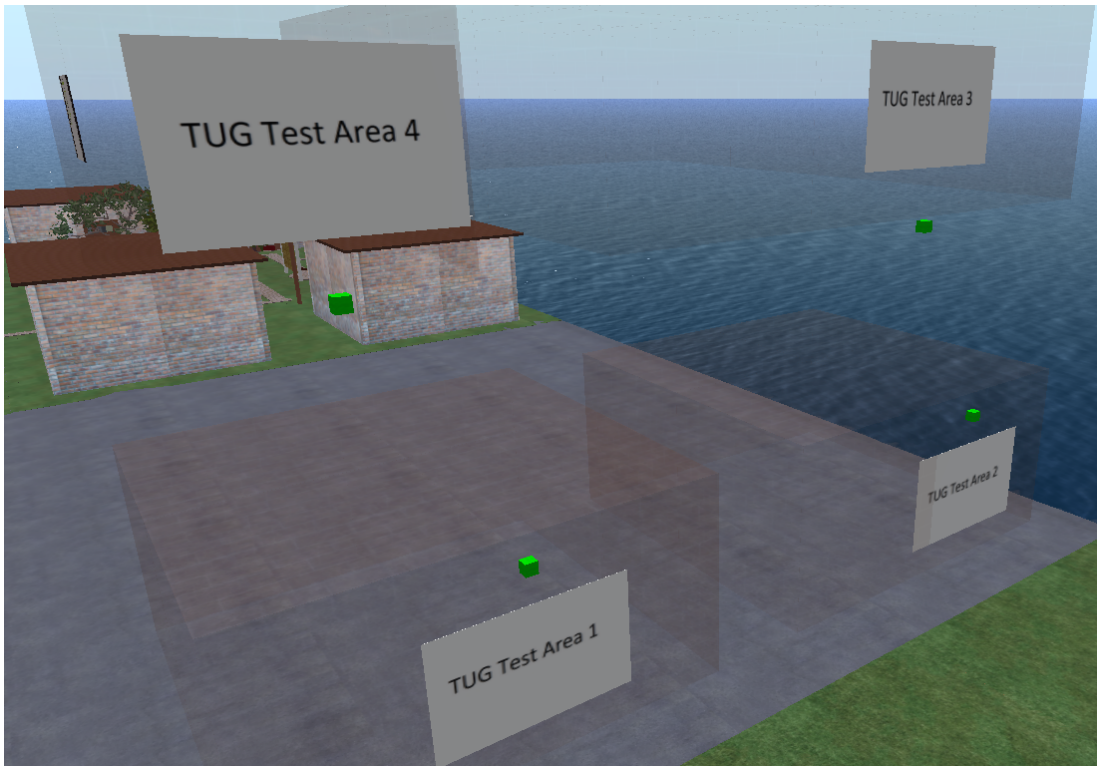


Figure 5.20: Multiple Areas

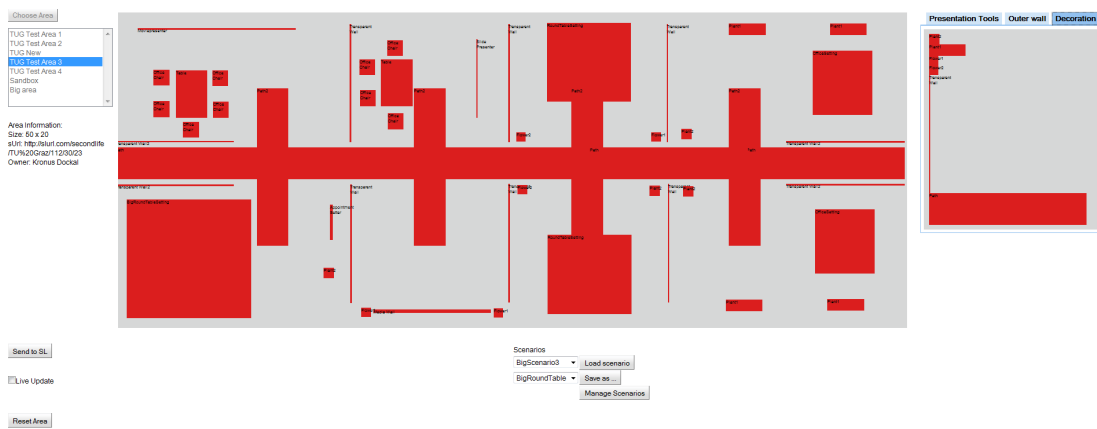


Figure 5.21: Big Scenario prepared to send to SL

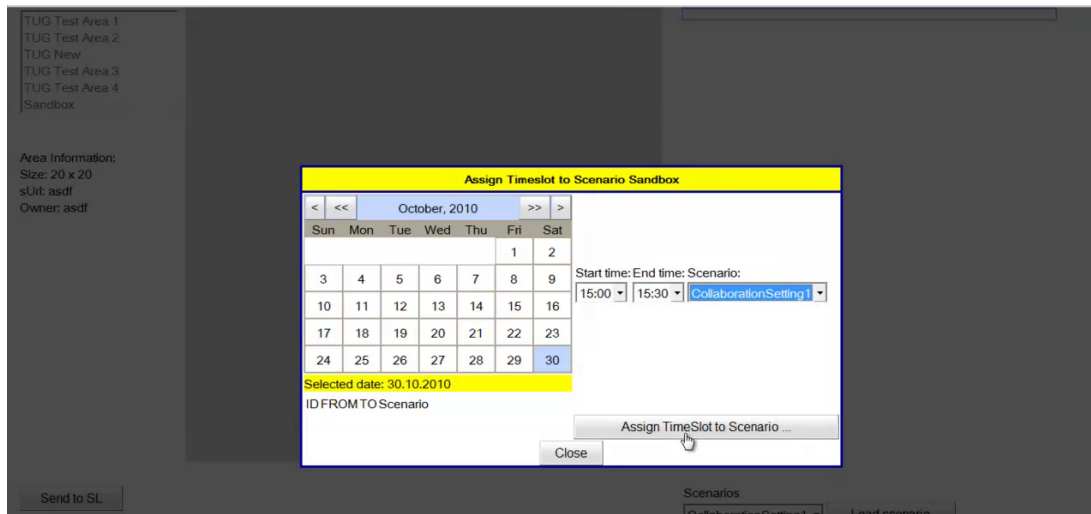


Figure 5.22: Assigning time slots to scenarios

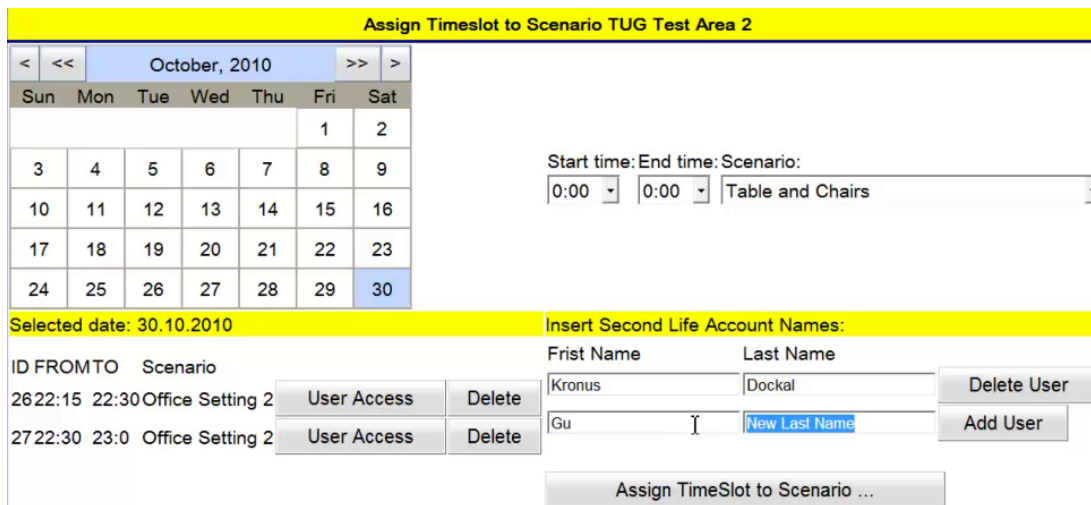


Figure 5.23: Controlling access to scenarios

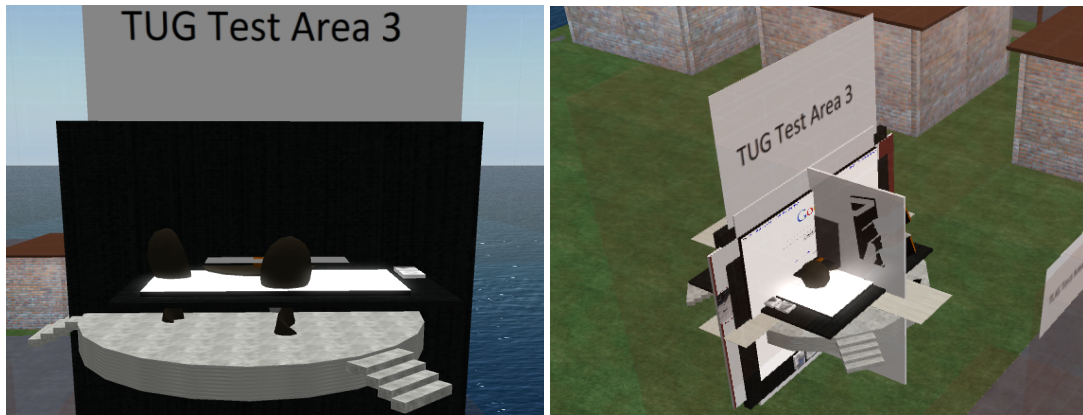


Figure 5.24: SL-Brain during receiving data and creating items

Figure 5.25: SL-Brain during receiving data and creating items

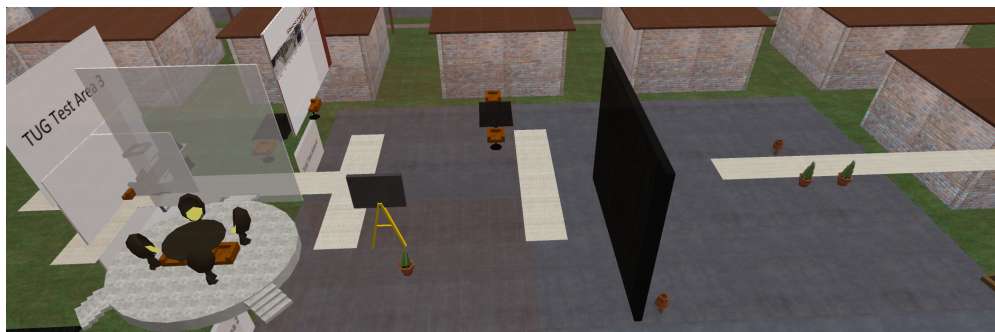


Figure 5.26: SL-Brain during receiving 'MOVE' commands



Figure 5.27: SL-Brain during creating the wall

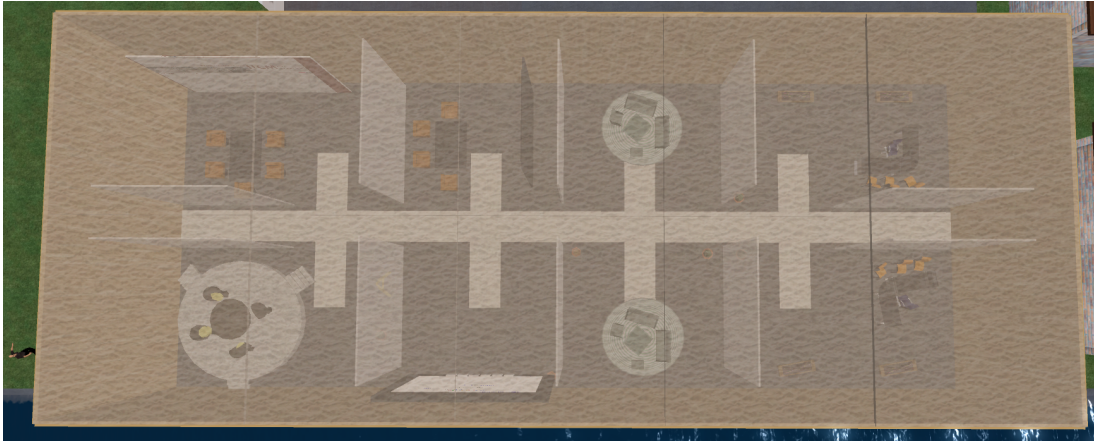


Figure 5.28: SL-Brain finished



Figure 5.29: Controlling access to scenarios

5.4 Findings

5.4.1 Developers Point of View

From an implementation point of view there are several positive aspects and obstacles.

Working with Second Life

The development in Second Life with LSL is easy to learn for a skilled programmer. It is easy to get used to LSL and the programming in the virtual reality. There are also many 'in world' places where it is possible to learn to program in Second Life. We have experienced the very engaged user community as a big benefit coming along with the platform. Coming to the disadvantages, the subsequent points list the problems and restrictions while working and programming in Second Life:

- *Costs*
Linden Labs charges for uploading images, sounds, animations and ownership of land.
- *No real privacy*
There is no option to ban avatars from looking into closed buildings or rooms. Creating walls and scripting barriers is pointless, as long every avatar is able to use the camera angle to look into a room.
- *Creating textures for writing*
Writing can only be realized by creating textures, that display characters.
- *Only one media per parcel*
In our version of the Second Life viewer (1.x) only one media per parcel was supported at the same time. That limiteds the collaboration tools which use medias to one per area.
- *Prims per parcel limited*
The amount of prims per parcel is limited, which can easily exceeded.
- *Moving of objects*
Programming in Second Life, especially object movements, can be challenging as well. If the program moves an object to an incorrect Second Life coordinate, the prim will disappear and be almost untraceable. Usually a restriction of 10 meters limits this, but in our script objects make stopovers every 10 meters to avoid this error.

- *Control prims without scripts*
Unfortunately it is not possible to get access to prims without including scripts in them. That means every single object needs a LSL script and a unique ID to be controlled by the 'SL Brain'. Equally it has to be added in the database with its exact dimensions and description. This means a lot of work for the developer.
- *Rezzing objects from inventory*
Every item and avatar in Second Life has its own collection of SL objects, called inventory. If a prim wants to be accessed or 'rezzed' by another prim, it has to be kept in the inventory of the root object.
- *Limited rezzing distance*
If one object wants to rez another object on a different position as its own, the distance for that is limited to 10m. Thus it has to move to the more distant location. This restriction finds application when the 'SL-Brain' creates the exterior walls of the learning areas.
- *Time delay through LSL scripts*
Further LSL methods, especially the method to rez objects produces time delays (SecondLifeWiki, 2010d).
- *Copyrights of bought objects*
The trading system in Second Life offers several opportunities of copyrights for the author. It is possible to buy objects with locked scripts. That prevents the necessary option to include the script, which is able to communicate with the 'SL Brain'
- *Utilization of the SL islands*
As mentioned in Section 2.7.2, each 'sim' runs on a single instantiation of a server. Thus, on very popular islands, with many scripts running, the execution of scripts can delay or lack, which results in loosing data.
- *Center of a multi-part prim*
The SLRoomManager always assumes, that the entered coordinations, in the database, belong to the center of the prim. If an item is made of several prims, always the last highlighted prim, when the developer combines them, is the center position of the complete object. Therefore, a wrong centered multi-part object, may be positioned wrong.
- *Unique rezzing ID*
To rez an object via script from another prim, it is necessary to do that by

their name. Thus this name has to be unique. Especially if one uses similar objects, that can cause problems.

- *Unique communication ID*

In Second Life, objects can communicate via special channel IDs. If there are other scripts on an island, nobody can guarantee that these foreign scripts do not use the same channels to communicate. This can lead to faulty transmissions, or other scripts could monitor these transfers.

Off-world

Main part on the off-world development was the implementation with Google Web Toolkit (GWT). On the positive side, it was simple and convenient to develop web applications with Google Web Toolkit. The framework is easy to learn and the community is well represented. There are a number of websites which support (such as Roughian Examples ⁷ or GWT-Wiki⁸) programmers to find quick answers. The important advantages of GWT was the possibility of asynchronous remote procedure calls, the easy handling of drag and drop and that GWT uses JAVA.

The following points summarize the most significant drawbacks and problems of the development of the 'Off-world' part:

- *Communication from SL to an external application*

Usually a programmer develops a web application and a database on a local computer and transfers everything to a public server to finish it. In this process it is possible that the Web application is not accessible from the public Internet, because the developer does not have a public and static IP address or is behind a firewall. As the communication initiated by Second Life objects requires Internet access within the official IP range of the Web application, some workaround is required.

- *GWT browser independence*

In contrast to Section 5.2.2, where it is shown that GWT is browser independent, the developer made different experiences. Especially dimensions and look of widgets are distinguished among browsers. That is a problem if an application uses widgets for locating positions.

- *Access to a TOMCAT server*

GWT is running on a TOMCAT server. This kind of server is not so popular

⁷<http://examples.roughian.com/>

⁸<http://code.google.com/p/google-web-toolkit/w/list>

as a simple HTTP webserver. Thus it was more difficult to organize a TOMCAT server at the university.

- *PHP Script*

The 'Backend Interface' got realized through a simple PHP script which communicates between Second Life and the database. A better way is to run everything on the same platform as the main part, the 'User Interface', on 'Apache TOMCAT'.

In summary, these drawbacks of developing with 'Google Web Toolkit' are not really devastating. The advantages still outweigh the disadvantages which aims that the developer of the prototype can highly recommend working with GWT.

5.4.2 Users Point of View

The project is still in a prototype and infancy phase. The initial findings from assessment of the proof of concept are outlined within this Section. The 'User Interface' has been developed to be intuitive and easy to operate. There are also known problems that include the following:

- *Clarity of the User Interface*

The GUI pop-up menus do not show everything immediately. That can be a problem if the user uses lower screen resolutions or more functions will be added. For future work, a simple general menu has to be included.

- *Help*

Currently there is no help included, thus a user cannot solve problems or ambiguities on his own.

- *No status from SL*

The user interface does not show a status from the transferred data into Second Life. As for Second Life the current design decision leads to the following problems: if the connection between SL and the web is broken or an LSL script delays for too long, the commands for the 'SL Brain' can be lost. This kind of error cannot get absorbed or detected as there is only a one way connection between the 'SL Brain' and the objects. That means the 'SL Brain' transfers the commands to the controlled objects, but does not check if the command was executed.

- *No status from the SLRoomManager*

If a learning environment has been realized by the 'SLRoomManager', no status in Second Life is realized, when the setting is finished. It would help if a in-world status bar would show the progress of the work.

These problems are known and should be solved in a next version of the application. But by the fact that the aim of the project was to create a first proof of concept, a prototype, these drawbacks can be accepted.

5.4.3 Case Study

The project got evaluated in relation to their usability. Aim of the testing was to find out if the general idea got implemented. The prototype should be flexible and self-explanatory for the user and it should realize the created environment in Second Life.

Design

The test persons were asked general questions at the beginning. After an introduction into the application, the proband had to fulfill two tasks. In particular, an easy environment setting and a saved scenario had to be assigned with a time slot and two Second Life users had to grant access to the scenario. Afterwards, the test person was asked about the completed tasks.

The complete survey, which is designed in a qualitative approach, is attached at the end of this document, Appendix C.

Results

The exact answers, of all five test persons, are saved at the CD-ROM, attached to Appendix D. The subjects were mainly male students between 25 - 34 years with above-average computer skills. Unfortunately the respondents had no significant experience with Virtual 3D Worlds. The following points show the indicated results of the interview:

- Persons with professional computer experience had no problem to work with the 'SLRoomManager' and to fulfill the tasks
- All interviewed persons responded that the project simplifies the usage of Second Life and the tool is easy to handle.
- Benefits of the prototype:
 - Easy creation of learning scenarios
 - Less Second Life skills necessary
 - Time saved with the 'SLRoomManager'

- Drawbacks of the prototype:
 - No feedback about the realization from Second Life
 - Limitation on the integrated objects at the 'SLRoomManager'
- Suggestions of the test persons:
 - Better design to be more intuitive
 - Better menu navigation for easier use

5.5 Discussion

To summarize this Chapter it is essential to reflect the start of this practical part of this thesis.

The research in literature and the survey defined the requirements for this project. The tool should support the creation of 'Second Life Learning Environments' with an external service without an interaction in-world in an easy and intuitive way and should be flexible according to different learning settings.

Through the eagle eye view, in combination with the possibility of drag and drop, the 'web-application' is easy to handle. An user can intuitively create a learning environment without special knowledge of Second Life. In almost the same manner, a tutor or assistant can prepare scenarios for defined time slots. These assigned collaborative settings can be limited in their access through the 'SLRoomManager' as well.

These results show that the project was a success. Almost all requirements have been implemented with the prototype. Alone the request of sending a feedback from Second Life back to the tools, has not been integrated yet, but that should not be a problem for the next version of the project.

'The 'SLRoomManager' should be a prototype, a experiment if it is possible to 'telecommand' Second Life for a certain scope of learning settings. The evaluation at the end of this Chapter shows, that the project was a success. All the test persons answered that the project simplifies the usage of Second Life to build learning environments and it was easy to handle, whereby the requirements get achieved.

Coming to a resume of the benefits:

- The 'SLRoomManager' enables students and tutors to create their personally preferred learning environment in Second Life in an easy way.
- It is possible to reuse and adapt old scenarios.
- With assigning time slots to scenarios, the setting is created only on-demand and deleted afterwards. This saves real money, because less Second Life is needed.
- To get privacy the access to scenarios can get controlled.

The project generates new ideas and options for using Second Life for educational applications. But the restrictions and limitations of Second Life narrows down the transposition for advanced projects. Especially the following problems complicate the decision about continuing the project with Second Life as the Virtual World :

- No possibility of controlling prims without a prepared LSL script.
- Performance problems of LSL scripts.
- High costs for land and uploading data.
- Limitation of prims per parcel.
- Copyright of bought objects.

An other concept could be the switch to a similar platform. 'Open Simulator' offers almost the same features as Second Life, but is less restricted and easier expandable for more projects.

Chapter 6

Lessons Learned

To work on this project and the possibility to work with an international team in Australia created a big benefit for me. The following resumé describes my personal development in detail.

To start a project in a foreign country and at a new university widen my horizon enormously. After overcoming several barriers with a foreign language and a new culture, the stay in Perth was a wonderful experience which I never want to miss. The team of the institute of 'Information Systems' at Curtin provided a warm as well as a scientifically competent and organized environment, especially 'Muriel Bijoux' and 'Naomi Dreher' had always an open ear for problems.

Curtin Business School, the faculty of 'IS', supplied us with a fully equipped workshop, 24 hours accessible. At the same time, our colleagues and supervisor helped us to organize issues, arrival problems, settling in and furthermore introduced us to local customs.

This collaboration with an international research team, has improved my team spirit and was a very good preparation for working in an international company.

Autonomously starting to work in a field, asks for a lot of reading and reviewing. Unfortunately not all the literature is easy of access, but the Curtin University and Graz University of Technology provides access to many research resources, but these services are also limited and restricted. After a short period of time I had to accept those formal restrictions. Another problem in relation to literature research was the little experience of the author. Writing my first major scientific work, I learned a lot in this respect.

Another important milestone was programming and working in Second Life. As easy it is to install and access Second Life's user client in the first place, as complicated it can be to solve upcoming issues while creating in-world contents. Not having a Second Life expert available to consult, I wasted a huge amount of time trying to solve issues assigned to scripting tasks, that were not even realizable within this framework. To avoid such a waste of time I kindly recommend a frequent use of Second Life's online forums and literature, where mainly experienced users give fast and competent answers.

To sum up the section, one could say it is helpful to schedule some extra time for initial literature research, in particular if it happens to be written in any other than the reader's mother tongue. Also, it is worth to take into account, that a basic knowledge of programming helps to get used to a new development framework, as it happened with 'Google Web Toolkit'. The prerequisites about Java helped enormously when incorporated into the new environment. Coming to a conclusion, a detailed initial planning phase is essential for a positive project result and can hardly be overrated.

Chapter 7

Summary and Outlook

In this document, we described a first proof of a concept of a technology to support changeable learning situations in a virtual learning environment. The proof of the concept in Second Life virtual learning environment is flexible and adaptable to match the instructors' learning design and the students' learning styles. The GUI system which is accessible via a web browser is intuitive and simple to use. A reusable library of learning tools and inventory of 3D objects available for users to choose from. The system is easy to configure, learning settings can be re-used to meet the actual needs of the learning communities.

The current prototype is focused on the transfer of information from an external media into Second Life. A future challenge of this project is to design a bi-directional communication between the Web application and Second Life. This will open up many possibilities for new features which will include the following:

- Implement more commands to create and manage the presentation tools, for example set up URLs, upload slides or movies via the website for collaboration tools.
- Transfer scenario and avatar status to the web application.
- Get feedback from the scenarios.
- Get information and positions from external objects (not objects from the 'SL Brain').
- Include a zoom option into the web application to position objects more accurately and to manage bigger areas.

- Automatic recording of new objects into the database. The 'SL Brain' can send unknown objects with their dimensions and properties to the Web application, however, it is still a manual process to include a new object the prepared LSL script and save to the 'SL Brain' inventory.
- Develop the GUI as a 3D model to be more intuitive.
- Include 'Help' messages if the user has problems or ambiguities.
- Include security measures, like a safe user management with different rights at the user interface.
- Expand the support of various time zones.
- Expansion of the area of responsibility of the SL-Brain to complete islands.

If these points are implemented, the tools must be tested over a long period by students and tutors, to find more problems and new opportunities.

The situation thus far has motivated us to initiate further research to realize an adaptable and flexible system to enhance learning which is accessible by the learning communities.

Bibliography

- Activeworlds, I. (o. J.). *The activeworlds corporation*. (<http://www.activeworlds.com/info/index.asp>; visited on September 28th, 2010)
- Allen, D. (2007, 06). *New virtual worlds to conquer in china*. (http://www.atimes.com/atimes/China_Business/IF28Cb01.html; visted on November 29th, 2010)
- Barlow & Perry, J. (1990). Being in nothingness virtual reality and the pioneers of cyberspace. , 34-43. (http://w2.eff.org/Misc/Publications/John_Perry_Barlow/HTML/being_in_nothingness.html; visited on September 19th, 2010)
- Bartle, R. (2003). *Designing virtual worlds*. New Riders Games.
- Bates, T. (2005). *Technology, e-learning and distance education*. Routledge.
- BlizzardEntertainment. (2008). "world of warcraft subscribers base reaches 11.5 million worldwide". (Press release posted December 23rd 2008, available at: <http://eu.blizzard.com/en-gb/company/press/pressreleases.html>; visted on July 31th 2010)
- BlizzardEntertainment. (2010a). *Technology f.a.q*. (<http://www.worldofwarcraft.com/info/faq/technology.html>; visted on August 14th, 2010)
- BlizzardEntertainment. (2010b). *World of warcraft screenshot of the day*. (Screenshot number 86 of 118 available at <http://www.worldofwarcraft.com/downloads/ssotd>; visted on August 14th, 2010)
- Britain, S. & Liber, O. (1999, 10). *A framework for pedagogical evaluation of virtual learning environments* (Report Nr. 41). Heriot-Watt University: JISC Technology Applications Programme. (<http://www.jisc.ac.uk/media/documents/programmes/jtap/jtap-041.pdf>; visted on October 6th, 2010)
- Brown, B. & Bell, M. (2004). Cscw at play: 'there' as a collaborative virtual environment. In *Cscw '04: Proceedings of the 2004 acm conference on computer supported cooperative work* (S. 350–359). New York, NY, USA: ACM.

- Bungenstock, M. (2006). *Entwurf und implementierung einer vollständigen infrastruktur für modulare e-learning-inhalte*. Dissertation, Universität Paderborn. (<http://ubdok.uni-paderborn.de/servlets/DerivateServlet/Derivate-5278/disserta.pdf>; visted on December 21th, 2010)
- Callaghan, V., Gardner, M., Horan, B., Scott, J., Shen, L. & Wang, M. (2008). A mixed reality teaching and learning environment. In J. Fong, R. Kwan & F. Wang (Hrsg.), *Hybrid learning and education* (Bd. 5169, S. 54-65). Springer Berlin / Heidelberg. Verfügbar unter http://dx.doi.org/10.1007/978-3-540-85170-7_5
- Castronova, E. (2001). *Virtual worlds: A first-hand account of market and society on the cyberian frontier* (CESifo Working Paper Series Nr. 618). CESifo Group Munich. Verfügbar unter http://econpapers.repec.org/RePEc:ces:ceswps:_618
- Childers, B. (2009). Run your own virtual reality with opensim. *Linux J.*, 2009 (179), 6.
- Chittaro, L. & Ranon, R. (2007). Web3d technologies in learning, education and training: Motivations, issues, opportunities. *Computers & Education*, 49 (1), 3 - 18. Verfügbar unter <http://www.sciencedirect.com/science/article/B6VCJ-4GPW3CF-1/2/54038f95d83ba2b37ead481d59b2a10a> (Web3D Technologies in Learning, Education and Training)
- Collins, S., Bentley, K. & Conto, A. (2008). *Virtual worlds in education* (Bericht). EDUCAUSE Evolving Technologies Committee.
- Cox, R. & Crowther, P. (2009). *A review of linden scripting language and its role in second life* (Bd. 5322; M. Purvis & B. Savarimuthu, Hrsg.). Springer Berlin / Heidelberg.
- Dalgarno, B. & Hedberg, J. (2001). 3d learning environment in tertiary education. *ASCILITE Melbourne, Victoria*, 33-36.
- Farmer, R. (1992). *Social dimensions of habitat's citizera3*. (<http://www.crockford.com/ec/citizenry.html>; visited on July 20th 2010)
- Franceschi, K., Lee, R. & Hinds, D. (2008, 7-10). Engaging e-learning in virtual worlds: Supporting group collaboration. In *Hawaii international conference on system sciences, proceedings of the 41st annual* (S. 7 -7).
- Freitas, S. D. (2008, 11). *Serious virtual worlds. a scoping study*. (Prepared for the JISC e-learning programme; <http://www.jisc.ac.uk/media/documents/publications/seriousvirtualworldsv1.pdf> visted on November 8th, 2010)
- Gardenvale, P. (2007, November). There.com - makena technologies creates an imaginative and playful world. *The Seventh Sun*, 1(11), 22-23. (<http://theseventhsun.com/7thSun.Vol1No11.thereDotCom-registered.pdf>; visited on August 26th, 2010)

- Google. (2010). *Google web toolkit*. (<http://code.google.com/webtoolkit>; visted on December 3rd, 2010)
- Gütl, C. & Chang, V. (2008). Ecosystem-based theoretical models for learning in environments of the 21st century. *International Journal of Emerging Technologies in Learning (iJET)*, 3, 50-60.
- Gütl, C., Chang, V. & Freudenthaler, S. (2010). *How to support more flexible learning settings in second life*.
- Guomin, Z. & Jianxin, Z. (2010). An educational value analysis of sloodle-based distributed virtual learning system. In *Education technology and computer science (etcs), 2010 second international workshop on* (Bd. 3, S. 402 -405).
- Henke, G. (2007). *Lsl schnell und kompakt* (Bd. 1; P. Kienle, Hrsg.) (Nr. 978-3-939084-92-1). entwickler.press.
- Hofweber, G. (2008, March). *Secondlife ist tot, project wonderland lebt*. Lecture on the CeBIT in Hannover. (<http://de.truveo.com/2nd-Life-ist-tot-Project-Wonderland-lebt/id/2198619255>; visted on August 26th, 2010)
- Holmberg, B. (2005). *The evolution, principles and practices of distance education*. Bibliotheks und Informationssystem der Universität Oldenburg.
- Hornik, S., Johnson, R. D. & Wu, Y. (2007). When technology does not support learning: Conflicts between epistemological beliefs and technology support in virtual learning environments. *Journal of Organizational and End User Computing*, 19 (2), 23-47.
- Hotrum, M. (2005, 03). Breaking down the lms walls. *The International Review of Research in Open and Distance Learning*, 6 (1), 1492-3831. (<http://www.irrodl.org/index.php/irrodl/article/viewArticle/212/295>; visted on November 29th, 2010)
- IEEE. (2002, 07). *Draft standard for learning object metadata*. (http://ltsc.ieee.org/wg12/files/LOM_1484_12_1_v1_Final_Draft.pdf; visted on October 15th, 2010)
- Jaschik, S. (2005, 10). *Blackboard vs....* (<http://www.insidehighered.com/news/2005/10/17/blackboard>; visted on November 29th, 2010)
- Jia, J. (2007, 09). *Lsl communications with internet*. (<http://sljia.wordpress.com>; visted on November 30th, 2010)
- Kandzia, P.-T. (2003). *E-learning für die hochschule* (Bd. 15) (Nr. 3-8309-1292-7). Waxmann Verlag GmbH.
- Kerres, M. (2001). *Multimediale und telemediale lernumgebungen: Konzeption und entwicklung* (Bd. 2) (Nr. 3-486-25055-8). Oldenbourg Wissenschaftsverlage GmbH.
- Klaus, C. (2008, 02). *Welcome to my world*. (<http://www.kaneva.com/community/news.kaneva>; visted on September 28th, 2010)

- Kock, N. (2008). E-collaboration and e-commerce in virtual worlds: The potential of second life and world of warcraft. *International Journal of E-Collaboration*, 4 (3).
- Kopeinik, S. (2010). *Virtual 3d worlds supporting collaborative learning settings in blended and distance learning*. Master thesis, Graz University of Technology.
- Korolov, M. (2010, February). *Laid off wonderland developers to continue project*. (<http://www.hypergridbusiness.com/2010/02/laid-off-wonderland-developers-to-continue-project>; visted on August 26th, 2010)
- Latteman, C. (2009). *Virtuelle welten*. Online. (<http://www.enzyklopaedie-der-wirtschaftsinformatik.de/wi-enzyklopaedie/lexikon/daten-wissen/Wissensmanagement/Soziales-Netzwerk/Virtuelle-Welten>; visted on July 23th 2010)
- Lee, F. S. L., Vogel, D. & Limayem, M. (2003). Virtual community informatics: A review and research agenda. *JITTA : Journal of Information Technology Theory and Application*, 5(1), 47.
- LimeSurvey. (2010). *Features*. (<http://www.limesurvey.org/en/about-limesurvey/features>; visted on November 24th, 2010)
- Linden Research, I. (2010a). *Mainland pricing and fees*. (<http://secondlife.com/land/pricing.php?lang=en>; visted on August 24th, 2010)
- Linden Research, I. (2010b). *Second life statistic*. (<http://secondlife.com/statistics/economy-data.php>; visted on August 9th, 2010)
- Linden Research, I. (2010c). *What are the different levels of account membership?* (http://wiki.secondlife.com/wiki/Linden_Lab_Official:What_are_the_different_levels_of_account_membership;visted on August 24th, 2010)
- Livingstone, D. & Kemp, J. (2008). Integrating web-based and 3d learning environments: Second life meets moodle. *Upgrade - The European Journal for the Informatics Professional*, IX, 8-14. (<http://www.cepis.org/upgrade/files/2008-III-kemp.pdf>;visted on November 10th, 2010)
- Magenat-Thalmann, N., Kim, H., Egges, A. & Garchery, S. (2005, 12-14). Believability and interaction in virtual worlds. In *Multimedia modelling conference, 2005. mmm 2005. proceedings of the 11th international* (S. 2 - 9).
- Messenger, P., Stroulia, E. & Lyons, K. (2008). A typology of virtual worlds: Historical overview and future directions. *Journal of Virtual Worlds Research*, 1 (1). Verfügbar unter <http://journals.tdl.org/jvwr/article/view/291/245>
- Messenger, P. R., Stroulia, E., Lyons, K., Bone, M., Niu, R. H., Smirnov, K. et al.

- (2009). Virtual worlds – past, present, and future: New directions in social computing. *Decision Support Systems*, 47 (3), 204 - 228. Verfügbar unter <http://www.sciencedirect.com/science/article/B6V8S-4VTCM30-3/2/b21d5245d41753067eef8b2f8271dcd> (Online Communities and Social Network)
- Milligan, C. (1999, 12). *Delivering staff and professional development using virtual learning environments* (Report Nr. 44). Heriot-Watt University: JISC Technology Applications Programme. (<http://www.jisc.ac.uk/media/documents/programmes/jtap/jtap-044.pdf>; visted on October 6th, 2010)
- Müller, A. & Leidl, M. (2007). *Virtuelle (lern-)welten. second life in der lehre*. (http://www.e-teaching.org/didaktik/gestaltung/vr/SL_lehre_langtext_071207_end.pdf; visted on July 20th 2010)
- Monahan, T., McArdle, G. & Bertolotto, M. (2008). Virtual reality for collaborative e-learning. *Computers & Education*, 50 (4), 1339 - 1353. Verfügbar unter <http://www.sciencedirect.com/science/article/B6VCJ-4MY6N14-1/2/7b8bf0a3afee0e05558c2c37d9d55c2d>
- MoodleDocs. (2010, 10). *Features*. (<http://docs.moodle.org/en/Features>; visted on November 11th, 2010)
- Moodle.org. (2010, 11). *Moodle-statistic*. (<http://moodle.org/stats>; visted on November 11th, 2010)
- Nardi, B. & Harris, J. (2010). Strangers and friends: Collaborative play in world of warcraft. In J. Hunsinger, L. Klastrup & M. Allen (Hrsg.), *International handbook of internet research* (S. 395-410). Springer Netherlands. Verfügbar unter http://dx.doi.org/10.1007/978-1-4020-9789-8_24
- Nino, T. (2010). *Second life statistical charts*. (<http://dwellonit.taterunino.net/sl-statistical-charts/>; visted on August 9th, 2010)
- O'Driscoll, T., Trondsen, E. & Cross, J. (2007, 03). Another life: Virtual worlds as tools for learning. *eLearn Magazine*, 3 (2). (<http://www.elearnmag.org/subpage.cfm?article=44-1§ion=articles>; visted on December 15th, 2010)
- OpenSimulatorWiki. (2010a, 04). *Build instructions*. (http://opensimulator.org/wiki/Build_Instructions; visted on November 29th, 2010)
- OpenSimulatorWiki. (2010b, 08). *Configuration*. (<http://opensimulator.org/wiki/Configuration>; visted on September 29th, 2010)
- OpenSimulatorWiki. (2010c, 06). *Connecting*. (<http://opensimulator.org/wiki/Connecting>; visted on September 29th, 2010)
- OpenSimulatorWiki. (2010d, 08). *Faq*. (<http://opensimulator.org/wiki/FAQ>; visted on September 29th, 2010)
- OpenSimulatorWiki. (2010e, 9). *Opensim*. (<http://opensimulator.org/wiki/>)

- Main_Page; visted on November 4th, 2010)
- OpenSimulatorWiki. (2010f, April). *Screenshots*. (<http://opensimulator.org/wiki/Screenshots>; visted on September 28th, 2010)
- OpenWonderland. (2010). *Open wonderland faq*. (<http://www.openwonderland.org/about/faq>; visted on August 26th, 2010)
- OracleCorporation. (2010, January). *Oracle completes acquisition of sun*. (<http://www.oracle.com/us/corporate/press/044428>; visted on August 26th, 2010)
- Pestal, B. (2008). World of warcraft - vignetten aus einem virtuellen wunderland. *Die Maske - Zeitschrift für Kultur- und Sozialanthropologie*, 34-36. (http://www.diemaske.at/pdf/DIEMASKE_jaenner2008_BirgitPestal_worldofwarcraft.pdf; visted on August 14th, 2010)
- Pirkola, J. (2009, 4). *E-learning platform moodle integrated to opensim*. (<http://www.cybertechnews.org/?p=1383>; visted on November 15th, 2010)
- Porter, C. E. (2004, 11). A typology of virtual communities: A multi-disciplinary foundation for future research. *Journal of Computer-Mediated Communication*, 10 (1). (<http://jcmc.indiana.edu/vol10/issue1/porter.html>; visted on July 26th 2010)
- RedDarf. (2010). *Open source for the online gaming universe*. (<http://www.reddwarfserver.org/?q=content/open-source-online-gaming-universe>; visted on August 26th, 2010)
- Reinwand, I. & Reinwand, I. (2008, 03). *moove 3d-online-welt unter dem aspekt der green-it*. (Press release; available at http://www.moove.de/PM_moove_green_IT1.pdf; visted on September 28th, 2010)
- Roberto Barchino, S. O., José M. Gutiérrez. (2005). *An example of learning management system* (Poster/Demonstration Nr. 1).
- Rose, J. (2009, 11). *elearning or distance learning disadvantages; why to not choose distance education as a training model*. (<http://www.suite101.com/content/elearning-or-distance-learning-disadvantages-a175153>; visted on November 4th, 2010)
- Schulmeister, R. (2005). *Lernplattformen für das virtuelle lernen; evaluation und didaktik* (Bd. 2) (Nr. 3-486-27573-9). Oldenbourg Wissenschaftsverlage GmbH.
- SciLandsBlog. (2010). *Scilands classroom*. (<http://classroom.scilands.org>; visted on November 15th,2010)
- SciLandsSenate. (2010, 10). *Letter to linden lab*. (https://docs.google.com/document/pub?id=1hZToZ6_NA9LuKNdYEQ_ixYyp766EmvCXTV-VfEIbtFY; visted on December 21th, 2010)
- SecondLifeUpdate. (2007). *Top 10 online 3d virtual worlds*. (<http://www.secondlifeupdate.com/uncategorized/top-9-online-virtual-3d>

- worlds; visted on July 22th 2010)
- SecondLifeWiki. (2009a, 08). *Lsl communications*. (http://wiki.secondlife.com/wiki/Category:LSL_Communications; visted on November 30th, 2010)
- SecondLifeWiki. (2009b). *Lsl wiki: llrezobject*. (<http://wiki.secondlife.com/wiki/Listen>; visted on December 3rd, 2010)
- SecondLifeWiki. (2010a). *Getting started with lsl*. (http://wiki.secondlife.com/wiki/Help:Getting_started_with_LSL; visted on August 11th, 2010)
- SecondLifeWiki. (2010b). *Link*. (http://wiki.secondlife.com/wiki/Link_set; visted on August 11th, 2010)
- SecondLifeWiki. (2010c, 01). *Lsl integer*. (<http://wiki.secondlife.com/wiki/Integer>; visted on December 22th, 2010)
- SecondLifeWiki. (2010d, 12). *Lsl wiki: llrezobject*. (from <http://wiki.secondlife.com/wiki/LlRezObject>; visted on December 3rd, 2010)
- SecondLifeWiki. (2010e). *Primitive*. (<http://wiki.secondlife.com/wiki/Primitive>; visted on August 11th, 2010)
- SecondLifeWiki. (2010f). *System requirements*. (<http://secondlife.com/support/system-requirements/>; visted on August 11th, 2010)
- SecondLifeWiki. (2010g). *Viewer 2 quick start guide/interface overview*. (http://wiki.secondlife.com/wiki/Viewer_2_Quick_Start_Guide/Interface_overview; visted on August 10th, 2010)
- Sheehy, K., Ferguson, R. & Clough, G. (2008). Learning and teaching in the panopticon: Ethical and social issues in creating a virtual education environment. *International Journal of Social Sciences. Special Edition: Virtual Reality in Distance Education*, 2(2), 25-32.
- Shrivastava, P. (1998, 01). *Knowledge ecology: Knowledge ecosystems for business education and training*. (<http://www.facstaff.bucknell.edu/shrivast/KnowledgeEcology.html>; visted on December 14th, 2010)
- Simon, B. (2001). *E-learning an hochschulen* (Bd. 1) (Nr. 3-89012-886-6). Josef Eul Verlag.
- Sivan, Y. (2008). 3d3c real virtual worlds defined: The immense potential of merging 3d, community, creation, and commerce. *Journal of Virtual Worlds Research*, 1 (1). Verfügbar unter <http://journals.tdl.org/jvwr/article/view/278/234>
- Slender, G. (2009). *Developing with ext gut enterprise ria development*. Apress.
- Sloodle. (2010). *Simulation linked object and oriented dynamic learning environment*. (<http://www.sloodle.org/moodle>; visted on November 10th, 2010)

- Sloodle-Blog. (2010, 11). *About*. (http://www.sloodle.org/blog/?page_id=2; visted on November 11th, 2010)
- SouthParkStudios. (2006, 10). *Make love, not warcraft*. (South Park episode 1008; available at <http://www.southparkstudios.com/episodes/103797>; visted on August 13th, 2010)
- UniversityofWisconsin. (2005, 5). *Distance education history*. (<http://www.uwex.edu/ics/design/disedu2.htm>; visted on November 29th, 2010)
- Valerio, S., Pereira, J., Morgado, L., Mestre, P., Serodio, C. & Carvalho, F. (2009). Second life information desk system using instant messaging and short messaging service technologies. In *Games and virtual worlds for serious applications, 2009. vs-games '09. conference in* (S. 125 -132).
- Wagner, M. (2007, 3). *Inside second life's data centers*. (<http://www.informationweek.com/news/software/hosted/showArticle.jhtml?articleID=197800179>; visted on November 3rd, 2010)
- Warburton, S. (o. J.). Second life in higher education: Assessing the potential for and the barriers to deploying virtual worlds in learning and teaching. *British Journal of Educational Technology*, 40 (3), 414–426. Verfügbar unter <http://dx.doi.org/10.1111/j.1467-8535.2009.00952.x>
- WarcraftRealms.com. (2010). *Realm activity - warcraft*. (<http://www.warcraftrealms.com/activity.php?serverid=-1>; visted on August 10th, 2010)
- Warren, M. & Hutchinson, W. (2003). Information security – an e-learning problem. In *Advances in web-based learning - icwl 2003* (Bd. 2783, S. 21-26). Springer Berlin / Heidelberg. Verfügbar unter http://dx.doi.org/10.1007/978-3-540-45200-3_3
- Wiki jME. (2010, 09). *About jmonkey engine*. (http://jmonkeyengine.org/wiki/doku.php/about_jme; visted on November 29th, 2010)
- Wikipedia, t. f. e. (2010, 11). *Scilands*. (<http://en.wikipedia.org/wiki/SciLands>; visted on November 15th, 2010)
- Willkomm, S. (2009). *The virtual presence of the tu graz in second-life*. Master thesis, Graz University of Technology.
- Wilson, M. (2010, March). *There.com closed on march 9th, 2010*. (<http://www.there.com/info/announcement>; visited on August 26th, 2010)
- Wilson, T. V. (2007, 11). *How world of warcraft works*. (<http://electronics.howstuffworks.com/world-of-warcraft.htm>; visted on November 4th, 2010)
- world2worlds. (2008, March). *Project wonderland - 3d toolkit for building virtual worlds*. (<http://flickr.com/photos/26718459@N03/2506304773>; visted on August 26th, 2010)
- Worldofwarcraft.com. (o. J.). *Realm status*. (<http://www.worldofwarcraft>

- .com/realmsstatus/; visted on August 10th, 2010)
- Yankelovich, N. (2010, Janurary). *Good news and bad news: Wonderblog*. (http://blogs.sun.com/wonderland/entry/good_news_and_bad_news; visted on August 26th, 2010)

Appendix A

Online Survey

General questions

This section covers demographic questions of the participant.

1 Gender: *

Please choose **only one** of the following:

- Female
- Male

2 Age: *

Please choose **only one** of the following:

- <16
- 16-19
- 20-25
- >25

3 Your home continent: *

Please choose **only one** of the following:

- Africa
- Antarctica
- Asia
- Australia
- Europe
- North America
- South America

4 How far away do you live from the university/campus? *

Please choose **only one** of the following:

- On campus
- <3 km
- 3 - 10 km
- 11 - 20 km
- 21 - 30 km
- 31 - 40km
- 41 - 50km
- > 50km

5 Are you a student or a lecturer? *

Please choose **all** that apply:

Lecturer

Student

Other:

6 Are you working in addition to your study? *

Only answer this question if the following conditions are met:

° Answer was 'Student' at question '5 [004]' (Are you a student or a lecturer?)

Please choose **only one** of the following:

Full time work

Part time work

Not working

7 What is your level of computer expertise? *

Please choose **only one** of the following:

Absolute beginner

Beginner

Intermediate

Expert

Other

8 Do you have experience with "Learning Management Systems"? *

Please choose **only one** of the following:

Yes

No

A "Learning Management System" has the following main features:

- User management
- Lectures/unit/class management
- Role / right management
- Communication methods (chat, ...)
- Tools (Whiteboard, notepad, calendar, ...)
- Representation of content

9 Which LMS have you used before? *

Only answer this question if the following conditions are met:

° Answer was 'Yes' at question '8 [005]' (Do you have experience with "Learning Management Systems"?)

Please choose **all** that apply:

- Moodle
- Blackboard
- WBT - Master
- Other:

10 Do you have experience with virtual 3D worlds? *

Please choose **only one** of the following:

- Yes
- No

11 Which virtual 3D world have you experienced? *

Only answer this question if the following conditions are met:

° Answer was 'Yes' at question '10 [008]' (Do you have experience with virtual 3D worlds?)

Please choose **all** that apply:

- Second Life
- Java Wonderland
- World of Warcraft
- Sims
- Other:

General learning questions

Please give us a deeper insight on your learning style and learning behaviour.

12 If you have to complete a task/assignment or learn for an exam, which learning situation do you prefer? *

Please choose **only one** of the following:

- In a group
- In pairs
- Alone
- Other

13 If you want to revise the content of a lecture, which medium do you prefer to use? *

Please choose **all** that apply:

- Audio records
- Audio & video records
- Lecture notes
- Lecture slides
- Other:

14 Do you prefer to revise the content alone or in a group? *

Please choose **only one** of the following:

- Alone
- In a group

15 How do you revise the content with a group?

Only answer this question if the following conditions are met:

° Answer was 'In a group' at question '14 [015]' (Do you prefer to revise the content alone or in a group?)

Please write your answer here:

16 You have a question about a lecture/project/assignment. Which meeting situation do you prefer? *

Please choose **only one** of the following:

- Virtual mode - Ask my classmates or lecturer virtual (email, phone, forum, newsgroup, chat, ...)
- Physical mode - Ask my classmates or lecturer physical (office hours, campus, lecture,...)
- Other

17 Which communication medium do you prefer? *

Please choose **only one** of the following:

- Synchronous communication (phone call, meeting, roundtable, etc)
- Asynchronous communication (email, forum, newsgroup, etc)

18 In general, which medium do you prefer to communicate with? *Please choose **all** that apply:

- Email
- Chat via instant messenger such as MSN, IRC, ICQ, AOL, Skypechat, etc
- Call via Skype, Teamspeak, etc
- Meeting in virtual environments, like blogs, forums, Second life, etc
- Other:

Collaboration Questions**19 You have to create a document in a group, e.g. a project description or design document, etc.****Which application do you prefer to use to create such documents? ***Please choose **all** that apply:

- Systems like Subversion to share files
- Google Docs
- Zoho
- Wikis
- Slash
- Adobe Acrobat Connect
- Each member of the group will create different documents and combine at the end
- Other:

20 If you are working in learning groups, what was your most useful learning mode? *Please choose **all** that apply:

- Brainstorm together
- Create a document together
- Discuss about lecture/seminar/lesson
- Learning by teaching (prepare a presentation, ...)
- Practise calculations
- To learn content
- Work on a big project with all of these options, e.g. programmer project, ...
- Other:

21 If you are working in learning groups, how regular do you meet with your learning partners? *

Please choose **only one** of the following:

- Meet my learning partners for each learning sessions
- Meet my learning partnes for several learning sessions
- Meet my learning partners on an ad-hoc basis
- Other:

22 If you are working in learning groups, what was the most common reason to communicate with your partners beyond a meeting? *

Please choose the appropriate response for each item:

	very often	often	intermediate	rare	extremely rare
To make a appointment	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
To discuss questions	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
To share documents	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

23 How do you rehearse presentations? *

Please choose **all** that apply:

- Re-enact the real situation
- Rehearse in front of a mirror
- Video record
- Repeat it only for myself
- Other:

24 What kinds of material would support your learning? *

Please choose **all** that apply:

- Library
- Books
- Lecture scripts
- Technical systems, e.g. websites, ...
- lecture slides
- Video / Audio records
- Other:

Submit your survey.
Thank you for completing this survey.

Appendix B

Survey answers

Results

Number of records in this query: 333
Total records in survey: 333
Percentage of total: 100.00%

**Field summary for 001****Gender:**

Answer	Count	Percentage
Female (F)	111	33.33%
Male (M)	217	65.17%
No answer	5	1.50%
Non completed	0	0.00%

Field summary for 002**Age:**

Answer	Count	Percentage
(002a)	0	0.00%
16-19 (002b)	5	1.50%
20-25 (002c)	182	54.65%
>25 (002d)	141	42.34%
No answer	5	1.50%
Non completed	0	0.00%

Field summary for 003**Your home continent:**

Answer	Count	Percentage
Africa (003b)	3	0.90%
Antarctica (003e)	0	0.00%
Asia (003a)	6	1.80%
Australia (003g)	8	2.40%
Europe (003f)	276	82.88%
North America (003c)	10	3.00%
South America (003d)	25	7.51%
No answer	5	1.50%
Non completed	0	0.00%

Field summary for 007**How far away do you live from the university/campus?**

Answer	Count	Percentage
On campus (007a)	17	5.11%
< 3 km (007b)	117	35.14%
3 - 10 km (007c)	87	26.13%
11 - 20 km (007d)	27	8.11%
21 - 30 km (007e)	26	7.81%
31 - 40km (007f)	12	3.60%
41 - 50km (007g)	10	3.00%
> 50km (007h)	32	9.61%
No answer	5	1.50%
Non completed	0	0.00%

Field summary for 004**Are you a student or a lecturer?**

Answer	Count	Percentage
Lecturer (004a)	45	13.51%
Student (004b)	267	80.18%
Other <input type="text"/>	24	7.21%

Field summary for 009**Are you working in addition to your study?**

Answer	Count	Percentage
Full time work (009a)	40	12.01%
Part time work (009b)	128	38.44%
Not working (009c)	97	29.13%
No answer	68	20.42%
Non completed	0	0.00%


Field summary for 010**What is your level of computer expertise?**

Answer	Count	Percentage
Absolute beginner (010a)	2	0.60%
Beginner (010b)	14	4.20%
Intermediate (010e)	186	55.86%
Expert (010d)	126	37.84%
Other <input type="text"/>	0	0.00%
No answer	5	1.50%
Non completed	0	0.00%

Field summary for 005**Do you have experience with "Learning Management Systems"?**

Answer	Count	Percentage
Yes (Y)	136	40.84%
No (N)	192	57.66%
No answer	5	1.50%
Non completed	0	0.00%


Field summary for 006**Which LMS have you used before?**

Answer	Count	Percentage
Moodle (006a)	87	26.13%
Blackboard (006b)	50	15.02%
WBT - Master (006c)	30	9.01%
Other 	25	7.51%

Field summary for 008**Do you have experience with virtual 3D worlds?**

Answer	Count	Percentage
Yes (Y)	128	38.44%
No (N)	200	60.06%
No answer	5	1.50%
Non completed	0	0.00%

Field summary for 011**Which virtual 3D world have you experienced?**

Answer	Count	Percentage
Second Life (011a)	60	18.02%
Java Wonderland (011b)	13	3.90%
World of Warcraft (011c)	63	18.92%
Sims (011d)	51	15.32%
Other 	27	8.11%

Field summary for 014

If you have to complete a task/assignment or learn for an exam, which learning situation do you prefer?

Answer	Count	Percentage
In a group (014a)	61	18.32%
In pairs (014b)	77	23.12%
Alone (014c)	161	48.35%
Other <input type="text"/>	13	3.90%
No answer	1	0.30%
Non completed	20	6.01%

Field summary for 016

If you want to revise the content of a lecture, which medium do you prefer to use?

Answer	Count	Percentage
Audio records (016a)	18	5.41%
Audio & video records (016b)	74	22.22%
Lecture notes (016c)	232	69.67%
Lecture slides (016d)	142	42.64%
Other <input type="text"/>	8	2.40%

Field summary for 015

Do you prefer to revise the content alone or in a group?

Answer	Count	Percentage
Alone (015a)	260	78.08%
In a group (015b)	52	15.62%
No answer	1	0.30%
Non completed	20	6.01%

Field summary for 019

How do you revise the content with a group?

Answer <input type="text"/>	38	11.41%
No answer	295	88.59%
Non completed	0	0.00%

Field summary for 017

You have a question about a lecture/project/assignment. Which meeting situation do you prefer?

Answer	Count	Percentage
Virtual mode - Ask my classmates or lecturer virtual (email, phone, forum, newsgroup, chat, ...) (017a)	117	35.14%
Physical mode - Ask my classmates or lecturer physical (office hours, campus, lecture,...) (017b)	189	56.76%
Other <input type="text"/>	6	1.80%
No answer	1	0.30%
Non completed	20	6.01%

Field summary for 018

Which communication medium do you prefer?

Answer	Count	Percentage
Synchronous communication (phone call, meeting, roundtable, etc) (018a)	196	58.86%
Asynchronous communication (email, forum, newsgroup, etc) (018b)	116	34.83%
No answer	1	0.30%
Non completed	20	6.01%


Field summary for 031

In general, which medium do you prefer to communicate with?

Answer	Count	Percentage
Email (031a)	214	64.26%
Chat via instant messenger such as MSN, IRC, ICQ, AOL, Skypechat, etc (031b)	148	44.44%
Call via Skype, Teamspeak, etc (031c)	116	34.83%
Meeting in virtual environments, like blogs, forums, Second life, etc (031d)	43	12.91%
Other <input type="text"/>	13	3.90%


Field summary for 032

You have to create a document in a group, e.g. a project description or design document, etc. Which application do you prefer to use to create such documents?

Answer	Count	Percentage
Systems like Subversion to share files (032a)	75	22.52%
Google Docs (032b)	90	27.03%
Zoho (032c)	1	0.30%
Wikis (032d)	65	19.52%
Slash (032e)	1	0.30%
Adobe Acrobat Connect (032f)	42	12.61%
Each member of the group will create different documents and combine at the end (032g)	119	35.74%
Other 	23	6.91%


Field summary for 035

If you are working in learning groups, what was your most useful learning mode?

Answer	Count	Percentage
Brainstorm together (035f)	139	41.74%
Create a document together (035b)	55	16.52%
Discuss about lecture/seminar/lesson (035c)	168	50.45%
Learning by teaching (prepare a presentation, ...) (035g)	72	21.62%
Practise calculations (035d)	83	24.92%
To learn content (035a)	44	13.21%
Work on a big project with all of these options, e.g. programmer project, ... (035e)	69	20.72%
Other 	3	0.90%

Field summary for 036

If you are working in learning groups, how regular do you meet with your learning partners?

Answer	Count	Percentage
Meet my learning partners for each learning sessions (036a)	60	18.02%
Meet my learning partnes for several learning sessions (036b)	126	37.84%
Meet my learning partners on an ad-hoc basis (036c)	104	31.23%
Other 	4	1.20%
No answer	1	0.30%
Non completed	38	11.41%

Field summary for 037(037a)

**If you are working in learning groups, what was the most common reason to communicate with your partners beyond a meeting?
[To make a appointment]**

Answer	Count	Percentage
very often (1)	49	14.71%
often (2)	110	33.03%
intermediate (3)	101	30.33%
rare (4)	29	8.71%
extremely rare (5)	8	2.40%
No answer	1	0.30%
Non completed	35	10.51%

Field summary for 037(037b)

**If you are working in learning groups, what was the most common reason to communicate with your partners beyond a meeting?
[To discuss questions]**

Answer	Count	Percentage
very often (1)	70	21.02%
often (2)	138	41.44%
intermediate (3)	62	18.62%
rare (4)	20	6.01%
extremely rare (5)	7	2.10%
No answer	1	0.30%
Non completed	35	10.51%

Field summary for 037(037c)

**If you are working in learning groups, what was the most common reason to communicate with your partners beyond a meeting?
[To share documents]**

Answer	Count	Percentage
very often (1)	58	17.42%
often (2)	106	31.83%
intermediate (3)	89	26.73%
rare (4)	36	10.81%
extremely rare (5)	8	2.40%
No answer	1	0.30%
Non completed	35	10.51%

Field summary for 038**How do you rehearse presentations?**

Answer	Count	Percentage
Re-enact the real situation (038a)	69	20.72%
Rehearse in front of a mirror (038b)	46	13.81%
Video record (038c)	13	3.90%
Repeat it only for myself (038d)	224	67.27%
Other <input type="text"/>	14	4.20%

Field summary for 039**What kinds of material would support your learning?**

Answer	Count	Percentage
Library (039a)	138	41.44%
Books (039b)	245	73.57%
Lecture scripts (039c)	214	64.26%
Technical systems, e.g. websites, ... (039d)	217	65.17%
lecture slides (039e)	166	49.85%
Video / Audio records (039f)	81	24.32%
Other <input type="text"/>	6	1.80%

Appendix C

Post Survey

Case Study of the Second Life Room Manager

1. General questions:

- Gender
 - Male
 - Female

- Age
 - <25
 - 25-34
 - 34-45
 - >45

- What kind of academic staff or student are you?
 - Lecturer
 - research staff
 - tutor
 - student
 - other:

- What is your level of computer expertise?
 - absolute beginner
 - beginner
 - intermediate
 - professional
 - other:

- Do you have experience with virtual 3D worlds?
 - Yes
 - NO

- Which virtual 3D world have you experienced?
 - Second Life
 - Java Wonderland
 - World of Warcraft
 - Sims
 - Other:

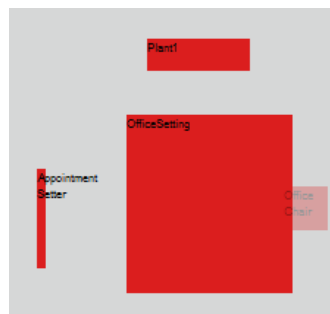
2. Testing Stage

Short introduction about the tool

Introducing movie available and test person can watch it

Task 1:

The test person should start the SL RoomManager Tool and Second Life and teleport to the prepared test area. After that, he has to choose "Test Area 2" and create following scenario and send the setting to Second Life:



Task 2:

The test person should start the SL RoomManager Tool and Second Life and teleport to the prepared test area. After that, he has to choose "Test Area 2" and assign "Test Scenario 2" with the Time "20:00" to "21:00" at the current day. In the next step he has to fill in the Name "Kronus Dockal" and "Melorie Boxen" to the assigned Timeslot.

3. Post – Test

- Evaluation Questions
 - Has the tool reached your expectations?
 - i. Yes
 - ii. No: Why not?
 - What are the advantages and disadvantages of the tool?
 - Any suggestions for improvement of the tool?
- General Questions regarding Task 1
 - The exercise was clear to my understanding.
 - i. Yes
 - ii. No: Why not?
 - I had no problems to complete the task.
 - i. Yes
 - ii. No: Why not?
 - I had stopped doing the exercise because
 - i. No
 - ii. Yes: Why?
 -
- General Questions regarding Task 2
 - The exercise was clear to my understanding.
 - i. Yes
 - ii. No: Why not?
 - I had no problems to complete the task.
 - i. Yes
 - ii. No: Why not?
 - I had stopped doing the exercise because
 - i. No
 - ii. Yes: Why?
- Benefits for students or tutor
 - The tool would simplify the usage of Second Life
 - i. Yes / No
 - The tool is easy to handle.
 - i. Yes / No
 - I would rather use SL for educational / collaborative work?
 - i. Yes / No

Appendix D

CD-ROM

- Source code of the off-world part.
- Source code of the SL-Brain.
- Source code of the special LSL script which contains every items.
- Screen shots and a video to show the functions of the project.
- Results of the Case Study.