Documenting a Virtual World - A Case Study in Preserving Scenes from Second Life

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ABSTRACT

In addition to the World Wide Web, other platforms have emerged on the Internet that are being used by communities to provide and exchange information. One family of such platforms are virtual worlds, which - like the Web - offer themselves for information exchange, e-commerce transactions and social interaction. While web data is successfully being collected and archived, the challenges met when trying to archive aspects from virtual worlds are significant. This paper describes an approach to archive information from virtual worlds, presenting a case study based on Second Life. We present a sociologically based alternative to the more technically-minded solutions aiming at preserving the very artifacts existing within virtual worlds. Our solution is based on creating an extension to the user viewport that will be used to record visual information, either in captured still images or movies, the same way a cinematographer would record a documentary movie. Using a combination of scripting commands within Second Life and third party image recording tools, we can give visual coverage of specified areas of interest within Second Life.

Keywords

Second Life, digital preservation, virtual worlds, game preservation, web archiving

1. INTRODUCTION

Beginning with the early days of the Internet, since before the World Wide Web even, virtual worlds and user-generated content have been part of both the future vision and the technological development surrounding it. Visualization through modern rendering engines has made virtual worlds both accessible and popular. Names like "World of Warcraft" or "Second Life" have become synonymous with this form of entertainment. This places them along a continuum of interaction forms on the Internet, ranging from static Web pages via social web applications and interactive streaming portals to on-line games and dedicated virtual worlds running within a closed environment, but potentially cross-linking to other aspects of the Web. Given the participative nature of these environments, the amount of information that is created there is directly proportional to the number of participants and the ultimate goal of the world. To give a rough estimate of the amount of potential content created in Second Life (SL), the Q1 2009 statistical figures published on a regular basis by Linden Labs, the company operating SL, exhibit a total of 124 million user hours spent in SL during the first quarter of 2009, together with a peak user number of 88.000 [5]. Both these figures show growth compared to the respective numbers during the first quarter of 2008, so both the community interest and the challenges to archival approaches are still growing.

The information we observe in virtual worlds is, also by nature of the Internet, short-lived: it often ceases to exist due to such trivial reasons as users canceling accounts, moving on and so on, or simply fades out due to being deemed out-of-fashion - a scenario very similar to the challenges met in archiving data from the Web. Multiple proposals for archiving strategies regarding virtual worlds exist already, most of them based on a technical understanding of protocols underlying the virtual worlds and information extraction. While this may preserve the content, i.e. the technical infrastructure, the objects and avatars existing in the virtual worlds, they fail to grasp another crucial aspect of virtual worlds, namely the type and means of interaction. Unlike static pages, virtual worlds in many aspects are more like social games, where the interactive nature and the actual (type of) interaction going on at a specific period of time, is as important as the actual world itself. Traditional web archiving approaches, as well as standard approaches to digital preservation, such as migration and emulation, thus cannot be used to conserve all aspects of virtual worlds such as Second Life. The dynamic and transient amount of information is very high and should not be excluded when attempting to preserve the essence of what made these worlds unique. A method that would catalog only the topology and static elements of a virtual world, lacking records of user activities, is missing characteristic elements of day-to-day life in these worlds, where the interactive aspect has a higher priority than in the conventional Web. In the same manner that a contemporary witness will also leave records of people and their activities as part of their report, our information gathering process needs to snapshot users and their interactions.

This paper thus proposes a complementary approach to the challenges of archiving virtual worlds, one that focuses on a natural documentation technique to produce information that is similar to modern TV and picture documentary products. We propose a solution which, in the particular case of Second Life, allows us to gather information the same way regular users perceive the world around them. We create and manipulate an object within the engine of SL to have it move through the virtual world and detect points of interest based on user activity and we perform a visual recording of such points of interest.

The remainder of this document is structured as follows: Section 2 gives an overview of related work that we found relevant to our experiment or used as a starting point for further research. Section 3 describes how we perform our experiment including the insights that we gathered while encountering various caveats. Section 4 delves deeper into the ethical implications of our work and finally, Section 5 proposes a few possible continuations and gives an outlook on future work.

2. RELATED WORK

Following in the footsteps of an increasing number of digital preservation initiatives focused on other media than the classic web page, there are various approaches to the preservation topics that influenced and motivated our work. Several approaches exist to deal with user generated video content, like the one presented in [8], based on the automated generation of metadata and tagging systems paired with video feature extraction. With the availability of these and more advanced types of analysis of video content, a video recording of interaction may serve as a suitable surrogate for preserving complex interactive digital content. This applies to session filming, a viable approach to capture the interactive nature of web pages. It has also been evaluated as a viable alternative to preserve interactive content such as video games [4].

The "Virtual World Initiative" [3] aims at constructing a dedicated Second Life experimentation environment for both archivists and digital presentation students. Also in focus are issues such as long-term preservation aspects, data architecture and portability, ethical aspects and, last but not least, providing an in-game environment inside SL which is encouraging to digital preservers. Our approach constitutes in some sense a diversification and continuation of some of the topics outlined there.

Figure 1: Recording camera, integrated with the Second Life HUD

A number of projects have been started addressing the preservation of virtual worlds. One valuable source of documentation about past activity in virtual worlds is the Internet Archive [2], which contains significant collections of video footage based on voluntary contribution of manually gathered footage. This, of course, does not scale well and requires much attention, but offers a higher degree of accuracy and content filtering than an automated approach. The same duality can be observed in standard web archiving initiatives, where we also find both the manual collection as well as the automated harvesting approach complementing each other, with priority being given according to an institutions mission statement. Examples of the footage stored in the Internet Archive include moments of cataclysmic impact in the existence of a select virtual world, often events related to closure or end. A proposal for automatically filming scenes in SecondLife, which is similar to the approach presented in this paper, was presented by Mohr [6]. Academic projects have also been started in collaboration with Linden Labs, aiming at a standardized and expandable process in virtual world archiving. An important deliverable of the "Preserving Virtual Worlds" project [1] is the definition of a metadata standard aimed specifically at archiving virtual worlds, allowing for the creation of a specialized ontology which would greatly help with accurate representation of preserved information, especially with regard to later evaluation and querying.

Ethical and legal implications need to be considered in all endeavors of collecting user-generated content. This may seem even more important when using a kind of "filming" approach, which is probably due to the wide-spread use and resulting concerns that video surveillance causes in the real world, even though that metaphor may have an entirely different function in virtual settings. Still, concerns similar to those voiced for web archives [7] apply to other (media) archives as well. The same problems regarding privacy, confidentiality and legality of the archival effort need to be addressed, and we feel that future work on the topics of opt-out means for users and economization of digitally preserved material need to be addressed. There are also many spontaneous discussions relating to this topic on popular web sites, usually sparked by controversial issues, like for example privacy concerns that archiving a virtual world would raise [9].

3. PROTOTYPE IMPLEMENTATION

In order to complement approaches focusing at data preservation, i.e. preserving the virtual world and its artifacts, our approach aims at preserving the interactive nature of a virtual world, capturing its rendering characteristics and the interaction and animation going on, very much in the spirit of [6]. To this end, we basically rely on the viewing engine of a virtual world as the starting point, recording all interaction as perceived by a user. Recording subsequently can take the form of image snapshots or include full video coverage including sound. The experiments reported below are based on Second Life as one of the most prominent virtual worlds that is used for a range of different purposes, including pure entertainment, education, collaboration and electronic commerce.

All our experiments are done using the regular SL Viewer and are thus subject to the restrictions implemented there. Since Linden Labs made the viewer available under the GNU GPL license, future work on this subject may benefit from modifying the source code rather than work around known limitations as we have done. Yet, not modifying and not depending on internal structure of the viewers leaves the approach more generic, more stable and more easily portable to other worlds.

The original goal of the experiment was to build a camera drone inside the Second Life world, using the tools for content creation provided by the regular SL Viewer, and to automate the drone to traverse the world and record still images or video footage while it does so. Technical limitations forced some changes to this general goal, as described in further detail below, yet the basic principle still applies.

We start by creating a 'prim' - a term for any basic object within SL - and experimenting with scripting its behavior via the proprietary Linden Scripting Language (LSL). Every object in Second Life can have an LSL script associated with it. The LSL program model is based on an extensible event model, and we aim to incorporate our own control logic in the LSL script associated with our prim. Originally, we had intended to have the camera object move independently from the avatar of the user logged in to perform the archival operation. However camera control is only possible for objects attached to an avatar or having an avatar sit on them (i.e. cars moving around), and thus not suitable for our requirement.

We thus devise a solution relying on integrating a scripted camera object in the SL Viewer ("HUD" in the SL terminology), merging it with the viewport of the current user, which allows the camera object to take control of the viewport and manoeuvre it around. Using this approach, we are able to remote control our camera object in the virtual world. While we move the camera, the avatar which is being used to attach the camera to will remain stationary. To other participants in second life, the camera object will be invisible.

The two main reasons we decided on this seemingly complicated solution as opposed to simply recording an avatar walking around with manual control are the need for remote manipulation of the camera on one hand - to provide automated archival capabilities that scale better than any manual method would, especially with scenarios over longer periods of time - and the non-intrusive nature of the virtual camera. The camera will be capturing SL content the same way a user avatar standing at the current viewport (not avatar) location would perceive it.

It is important to note that our solution, as it is based on scripting within the SL engine, requires scripting to be enabled in the respective game area. Since land owners in SL have the option to disable prim scripting ability for their areas - usually done in order to prevent abuse, irritation or harassment by malicious users - or "griefing"[1], as the Internet slang term labels these kinds of actions, this is something that needs to be determined before setting the archival targets.

[1]http://en.wikipedia.org/wiki/Griefing

Figure 2: A sensor array set-up for coverage of a Second Life sim

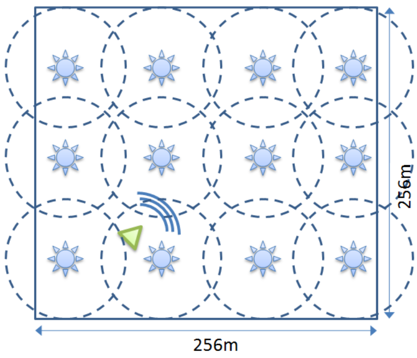

Figure 1 illustrates how our system captures SL visuals. The only difference to a regular SL viewport is the red circle in the upper right corner, which is the placeholder object that we scripted and anchored to the HUD. This way, the information that will be recorded will be as close to what a SL user would be perceiving in a first-person perspective as possible. There will be no other visible clue of the camera operator, more specifically no avatar.

With recording capabilities in place, we have to solve the path finding and navigation issue within the SL environment. To avoid complex coverage planning, we decided on creating the camera object as non-physical, which allowed us to move it through obstacles and avoid having to implement collision detection algorithms. Our first attempts were hindered by the fact that camera control reverts to the user avatar when script repositioning is used, thus rendering footage obtained that way very jerky and unusable. While there are quite a few development requests to the SL makers to incorporate camera control and attachment to non-avatar objects, and some third-party viewers for SL already support this feature, we take a different approach: We turn our camera into a so-called "HUD attachment", a special mechanic which allows the SL Viewer to integrate scripted objects in the visual display of the avatar. Originally intended for game play elements like radars or life gauges, it allows us to take control of the user viewport and manoeuvre it around like a floating camera, without the need to move the avatar.

With virtual worlds being huge in terms of space to cover we want to ensure that recording of interaction is concentrated on those areas where actual interaction is happening. We thus need to identify areas where there is some user activity, referred to as "hotspots" in our system. Hotspot activity detection is achieved by using the sensor functions from LSL and having them set up to scan for avatar/user instances. If our prim detects more than 10 avatars within a 10 meter radius, we classify it as a hotspot and slow down movement speed in order to record more images. When there are no avatars within 10 meters of the camera we warp the camera a fixed distance ahead. Our sensor data suffers from one fundamental flaw, though: since it is incorporated in an object attached to the avatar HUD, its scan is based at the avatar position. For future work, we propose to use an array of fixed sensors positioned in a grid across the SL area that shall be archived. The sensors will be positioned inside phantom objects that the SL viewer will not render, thus being invisible to the users, and will continuously monitor user activity around them. The sensors will then communicate their findings to the HUD attached camera, and the camera will evaluate the results and navigate towards the one hotspot that it computes as the most interesting based on metrics such as avatar numbers in the proximity. Using such a phantom sensor array requires set-up in advance and visible information to the area visitors about the archival project, of course. Assuming we want to cover a regular SL 'sim', which is a land area of 65.536m^2 contained within a square with a 256m edge, an exemplary archiving setup could look like the one depicted in Figure 2.

SL does not allow screenshot or video capture via the built-in scripting language. For that purpose, we use a third-party program, in our case FRAPS[2], a utility for video and image capture. FRAPS can be configured to take screenshots at specific intervals. Alternatively, video footage can be produced by recording the respective viewer output on screen. Again, combinatory approaches can be chosen, or more advanced, adaptive settings can be constructed, flexibly configuring and automatically adapting recording behavior similar to the strategies employed in continuous web archiving.

With the current static settings, the amount of data produced scales linearly with recording time. A couple experimental recordings in uncompressed .avi format at a resolution of 1680x1050 resulted in storage demands of about 1-1.3GB per minute of video stream at 30FPS. Compressing the video with the XVid codec yields a very good result, resulting in about 60MB per minute of video footage. Using XVid compression, one hour of video footage will amount to 3.6GB. Video capture presents the advantage of including ambient sounds and animations over still images.

Basing the archival strategy on screenshots instead requires about 150-160KB of storage per JPG image at settings of 1680x1050 resolution and 32-bit color depth with no compression. Assuming the recurring screenshot interval is set to 10 seconds, that would amount to roughly 9MB of screenshots per hour. Furthermore, given the nature of the graphics captured, significant levels of compression can be achieved as lossless image storage is probably not required for this type of data.

4. LEGAL ASPECTS AND ETHICS

When recording image data we need to consider both ethical and legal aspects of recording content and user-generated content within SL. According to the SL Terms of Service[3], Section 1.3: *Content available in the Service may be provided by users of the Service, rather than by Linden Lab. Linden Lab and other parties have rights in their respective content, which you agree to respect.[...] You acknowledge that: (i) by using the Service you may have access to graphics, sound effects, music, video, audio, computer programs, animation, text and other creative output (collectively, "Content").* From a legal point of view, using a regular copyright disclaimer stating that the copyrights are owned by their respective owners should be sufficient, given that the content is archived exclusively for non-commercial and non-profit utilization.

The ethical aspect turns out to be more complicated. The Linden Labs Privacy Statement states that: *You may choose to disclose personal information in our online forums, via your Second Life profile, directly to other users in chat or otherwise while using the Second Life service. Please be aware that such information is public information and you should not expect privacy or confidentiality in these settings.* This, in principle, renders all interaction and information provided via Second Life public, which may be interpreted as allowing others to monitor and collect information. In spite of this, the expected user attitude is often prominently and vocal against disclosure of chat logging and personal information outside of the SL world for reasons that are similar to those discussed in [7] for the Web in general. There is even a Community Standards policy by Linden Labs that states: *Remotely monitoring conversations, posting conversation logs, or sharing conversation logs without consent are all prohibited in Second Life and on the Second Life Forums.* Even though the latter has held little legal weight in the past when it came to usage of SL chat logs acquired without the consent of the participant users, it still illustrates an aspect that should be examined thoroughly before deploying archival systems for Second Life and other virtual worlds.

The legal and ethic research has been conducted without professional legal counsel and applying the current legislation valid in Austria. We are well aware that, should archival scenarios like the one we propose become deployed, further research in this area is required.

5. CONCLUSIONS AND FUTURE WORK

This paper proposed an alternative approach to preserving virtual worlds, focusing on interaction rather than the data structures and objects themselves. Similar to current archival recordings of virtual worlds produced manually, and reflecting documentary approaches in the social sciences, video footage is produced automatically by an avatar moving through a virtual world, focusing on areas with higher activity. Recording can be done either based on video footage or with sequences of image snapshots.

We find the method viable as a prototype, being however tied to the fundamental restriction of requiring the "run scripts" permission within the game world. During initial studies we found a large number of areas where scripting was prohibited. Given the implications for the privacy and intimacy of the involved users, and taking into account the restrictions we encountered, we propose our method as the method of choice for obtaining automated coverage of events of interest, in the same way a camera crew would record those events in the real world. The main benefit of our method lies in the automated operation once set-up is complete. It further supports monitoring heuristics with differing archival priority settings if a proper sensor network is set-up.

[2]http://www.fraps.com
[3]http://secondlife.com/corporate/tos.php

Both video and image capture can be enhanced by automatically combining it with a form of geotagging, i.e. by adding information regarding the location where the information was acquired to the image/movie data. This can be achieved both via metatags or naming conventions. Since filming/screen-shooting has to be done via third-party utilities when using the official SL viewer, tagging has to be performed by the capturing application, at least in a basic form that allows for post processing. A possible approach is to devise a controller application which feeds data to the SL viewer in the form of typed commands, the same way a human player would add comments.

There is also the perspective of using a specially compiled version of the Second Life client and adjust it to archival needs, given that the source code is available under the GNU GPL license. Such an approach would solve many of the inconveniences we found while trying to work within the current official version, which has obviously not been targeted to archival needs. Most notably, this would allow direct processing of SL environment data and enhancements to avatar or vehicle control.

Another issue that needs to be considered when deploying such archiving activities is post-processing of information gathered, with a focus on privacy and security issues. Tasks include user anonymization, conversation and name filtering, to name just a few. On the other hand, post-processing can also be used to mine structural information about the data gathered and make it available in the form of semantic maps.

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