

Is There Life in Second Life?

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ABSTRACT

Social virtual worlds such as Second Life are digital representation of the real world where human-controlled avatars evolve and interact around social activities. In this work, we perform an extensive analysis of Second Life. For this purpose, we crawled information on objects and avatars in more than 13000 Second Life's Regions over one month.

1. INTRODUCTION

A social virtual world is a computer-generated world where users interact using the Internet. It consists of a virtual land on which *objects* are created. Users interact via their digital representation, called *avatar*. Second Life¹ (SL) is the most widespread social virtual world.

The main motivation of this study is to understand the real size of social virtual worlds, in terms of content volume and active population. A complete study of a largely deployed architecture is useful to understand how social virtual worlds can be improved. In addition, this study permits to analyze the social behavior of human beings in a virtual context.

In order to conduct this study, we designed and deployed a *crawler* application to monitor SL. We chose SL since it is the most popular social virtual world. Our crawler is a modified SL client that exploits avatar capabilities to collect all available information about the virtual world. We monitored the public part of SL in April 2008, i.e. about 13000 Regions. The active population per day is about the 0.3% of the registered avatars. In addition, 90% of the Regions contain less than 10 avatars. Avatars tend to organize in groups with size between 2 and 10 avatars.

2. CRAWLER DESCRIPTION

The main idea behind a crawler application for SL is to exploit avatar capabilities to learn about the virtual world. To do so, we developed a modified SL client via libsecondlife², a set of C# libraries that allow third party applications to interact with SL. Our crawler is composed of multiple *sub-crawlers* (dotted blocks in Figure 1) dedicated to different monitoring operations. According to the load of each oper-

ation, multiple instances of each subcrawler are used. Each subcrawler instance must be associated to a registered avatar to accomplish the login to SL.

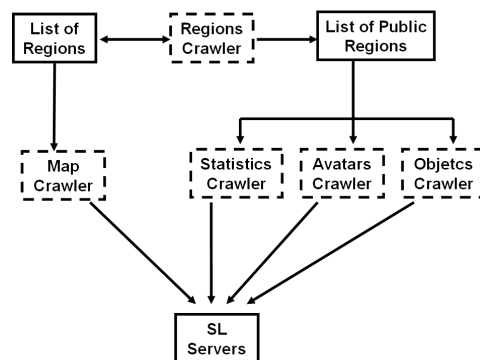


Figure 1: Scheme of the SL crawler

The *Regions Crawler* monitors the set of Regions in SL. This information has to be dynamically updated as new Regions are continuously created. It teleports to each Region and retrieves the set of neighbor Regions. In addition, Regions accessibility is verified.

The *Objects Crawler* traces the evolution of the user-generated objects in the public Regions. It teleports to a public Region and obtains coordinates and identifiers of all objects on the Region.

The *Statistics Crawler* collects the statistics maintained by the servers of the public Regions, i.e (1) Number of avatars connected, (2) Number of prims, (3) Time Dilation, (4) Total number of packets going in and out from the server.

The *Map Crawler* monitors the locations of avatars as shown on the official SL map. Given the identifier of a Region, it locates it on the map and retrieves the coordinates of all the avatars currently connected to this Region.

The *Avatars Crawler* obtains the identity and position of the avatars in the public Regions. Initially it retrieves from the map an indication of avatars positions in a public Region, then it teleports to each of these coordinates to detect the identities of nearby avatars.

In Table 1, we summarize the crawling performed in SL. We call Stat/Map/Av crawler a combination of the Statistics, Map and Avatars Crawler.

¹<http://secondlife.com/>

²<http://www.libsecondlife.org/>

| Crawler | Instances | IP@ | Regions | Frequency | Days |
|-------------|-----------|-----|---------|-----------|------|
| Regions | 3 | 1 | - | 1/24 hrs | 28 |
| Objects | 5 | 1 | - | 1/24 hrs | 28 |
| Statistics | 60 | 1 | 13052 | 1/90 min | 6 |
| Map | 40 | 1 | 17526 | 1/15 min | 3 |
| Stat/Map/Av | 60 | 5 | 5 | 1/30 sec | 3 |

Table 1: Second Life Crawling Summary

3. EXPERIMENTAL ANALYSIS

Our crawler discovers 17573 Regions. Among these Regions, 15725 are traceable on the SL map. 13261 of these Regions are public. The total surface occupied by the public Regions is roughly 870.000 km^2 . We identified about 7 Millions unique user-generated objects on this surface. The active population stays between 30000 and 50000 avatars. Figure 2 shows the avatar distribution. 45% of the Regions are empty and only 10% have more than 10 avatars. 2% have more than 20 avatars and show a very skewed distribution among them. Despite the maximum number of avatars per Region is 100, we see a cut-off of the distribution at about 80 avatars.

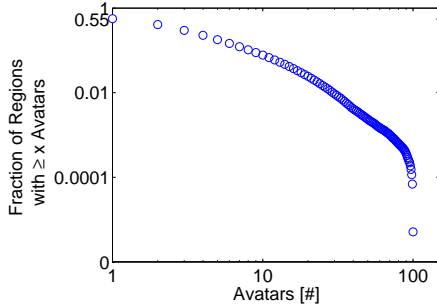


Figure 2: Avatar distribution [Map Crawler]

We call a *virtual crowd* a group of avatars that are all included in a visibility area. We used the k-means clustering algorithm [1] to identify the presence of virtual crowds. This algorithm allows to cluster n objects based on attributes into k partitions, where k is an input parameter. We consider avatars as objects to cluster and their coordinates as attributes; k is the number of virtual crowds. Since we cannot know k a priori, we iteratively increase k until every avatar is included in a cluster or virtual crowd with radius lower or equal to 35 meters, i.e. the visibility area of an avatar.

Figure 3 shows the distribution of virtual crowds sizes. 50% are composed by only one avatar. We conjecture that these avatars are either bots or users exploring a given Region. Then, 45% of the virtual crowds are made of 2 – 10 avatars. The budget of attention theory [2] says that human beings can only focus their attention to a maximum of 7-10 “points” at the same time. This is also apparently the case in virtual worlds. Finally we find very few virtual crowds larger than 20 avatars. We verified by visual inspection that these large group of avatars are driven by the presence of an event, such as concerts, shows, etc.

We now study the lifetime of the virtual crowds. We con-

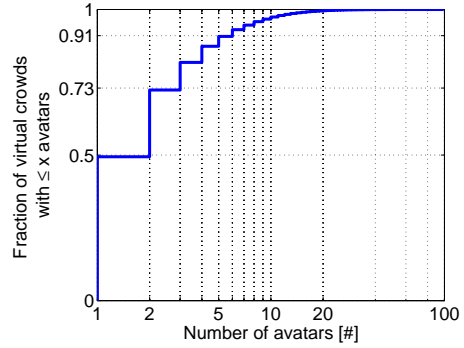


Figure 3: Distribution of virtual crowds size [Map Crawler]

sider the coordinates of a virtual crowd to identify it over time. However, the coordinates of virtual crowds can change as avatars move. For this reason, we introduce the following approximation: we say that a virtual crowd is still present on a Region when it has moved of less than an avatar visibility radius in comparison to its original position.

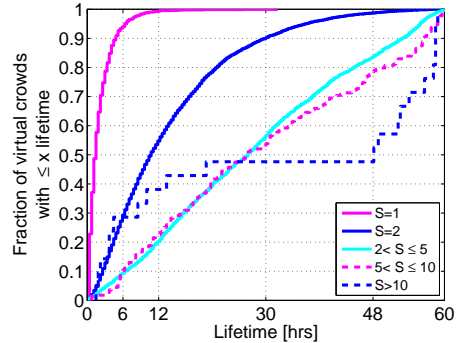


Figure 4: Virtual Crowds lifetime [Map Crawler]

Figure 4 shows the distribution of virtual crowds lifetime as a function of S , i.e. the average number of avatars seen in a virtual crowd during its lifetime. We see that the lifetime of a virtual crowd is proportional to S . This result indicates the presence of attractive points within a Region. For large virtual crowds, $S > 10$, we notice a strange behavior. In fact, 50% of these virtual crowds show a limited lifetime. We interpretate this result considering these virtual crowds as event driven. Finally, if we focus on the curve with $S = 1$, roughly 50% of these virtual crowds have a lifetime of few minutes. We identify on these virtual crowds avatars exploring a Region. Then, about 10% have a lifetime between 5 and 32 hours. This means isolated avatars nearly not moving for a very long time. We conjecture that this behavior is not coming from human beings, so we identify these avatars with bots.

4. REFERENCES

- [1] K. Alsabti, S. Ranka, and V. Singh. An Efficient K-Means Clustering Algorithm . 1997.
- [2] N. Cowan. The magical number 4 in short-term memory: A reconsideration of mental storage capacity. In *Behavioral and Brain Sciences* 24.