A review of Management Tools for OpenSimulator

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ABSTRACT

To host OpenSimulator virtual world servers at educational institutions, system administrators find at their disposal a diversity of web-based management systems with different sets of features. To support the selection among current management tools and provide a baseline from which to identify subsequent development needs, we installed and evaluated 4 of these systems (*WiFi pages, OSMW, MWI* and *jOpenSim*), analyzing and comparing their features. WiFi pages only provides account-management features. MWI has mostly the same features, but also provides systems administrators with the option of creating their own management website. OSMW has account-management and maintenance features, such as log management and editing of configuration files. jOpenSim provides features for account and event management and feature for generating some actions within virtual world, such as broadcasting a message to all regions. From matching the identified features with the literature-reported requirements for virtual world deployment at educational organizations, we conclude that there is no management tool that fulfils all the functional requirements reported in the literature and, therefore, that the adoption of current tools by system administrators will always require to manually perform some of the administrative tasks. We therefore call for development of novel, more encompassing administrative tools for OpenSimulator virtual worlds.

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1. INTRODUCTION

There are now many examples of virtual world use in support of learning and training. Their prototyping capabilities enable the rapid, inexpensive, creation and testing of three-dimensional objects, choreographies, and interaction scenarios for virtual actors. These enable concrete (i.e., non-abstract) renderings of theories, concepts, and ideas among students and teachers (Morgado et al., 2010). Also, the use of virtual reality can give the student the opportunity to experiment, through simulation, situations that if lived in the real world could be dangerous, expensive, or otherwise inaccessible. This can also be done in cooperation between simultaneous participants in the virtual world, geographically separated in the physical world (*ibid.*).

Various alternative technologies exist for using virtual worlds in education. Besides third-party hosting such as the well-known Second Life, or its purported successor Sansar, there are also several alternatives for hosting at the institutions themselves, which enable institutions to use only local resources, avoid virtual hosting fees, and control network access to the virtual world (Vilela *et al.,* 2010). Examples include somewhat recent platforms such as High Fidelity and Minecraft, and older solutions such as OpenCobalt and Project Wonderland. However, OpenSimulator (v.g. OpenSim) remains the most common virtual world hosting platform in education. Or, at least, the most commonly reported in practitioner and research presentations in conferences focusing on this field (e.g. VWBPE – Virtual Worlds Best Practices in Education, which announced its 12th edition for 2019 – https://vwbpe.org/).

However, being the most referenced does not mean that OpenSim (or any other virtual world) is in widespread use. This has been hindered by a variety of issues (Morgado, 2013), such as lack of integration with existing learning management systems and other organizational information systems, lack of support and knowledge for network profiling, content management at the organizational level (Morgado *et al.,* 2016, December), or user authentication federation (Cruz *et al.,* 2015). The overburdened list of administrative and technical tasks that the systems administrators must deal with, can hamper the OpenSim installations, making it very time consuming to set up and manage activities in these environments (Morgado *et al.,* 2016).

For systems administrators of typical educational organizations, an OpenSim server will be only one among a diversity of computing services that must be managed and serviced. The application structure of organizations, whether educational or otherwise, involves a huge diversity of services, which must be managed and

maintained by the systems administrators (Barret *et al.,* 2004). Having to control and manage an OpenSim installation may be seen as yet another unknown server software to be mastered by the people responsible for it. And if usage is not widespread within the institution, it may be a service whose management falls outside daily routines, making it time consuming for the system administrator to review procedures and refresh knowledge about the databases schemas and client-server communication protocols and prone to errors. Hence the importance of a system that systematizes and ensures the quality of its management, impacting on the degree of reliability perceived by users (in the case of an educational organization, teachers and students).

In this paper, we present the outcome of studying the features of four OpenSim management systems, to evaluate their applicability. Section 2 provides some background on OpenSim. Section 3 describes the management tools we installed as well as an overview of their features. Section 4 compares the different tools regarding their functionalities. Section 5 is where we draw conclusions regarding the obtained results.

2.   OpenSimulator

The OpenSimulator project (also known as OpenSim) is an extensible virtual worlds platform, built to simulate virtual multi-user three-dimensional spaces, where users can create objects (and modify or delete them) and, through scripts, program interactions and behaviors, considering variables representing physical characteristics of materials, as well as light sources defined in these virtual spaces (Fishwick, 2009). The configuration is managed through the text file "opensim.ini", which contains the environment parameters: users starting location coordinates; address for access and authentication; etc. (*ibid*.). The system is composed by virtual regions simulators and data services, which include user management, inventory storage, and others. A virtual region is a part of the virtual space where users and virtual objects can be located. The starting location is where users are placed by default upon logging in. An inventory is a personal virtual storage of each user where virtual items can be stored. For systems administrators, there is a diversity of such aspects that must be considered. For instance, OpenSim virtual worlds can be configured in Standalone mode, or in Grid mode. If the system is running in *standalone* mode, it executes the simulation of region and data services in a single computational process (opensim.exe) (Fig. 1). Thus, system administrators must consider the modes and their available physical and virtual machines when pondering OpenSim installations and configuration.
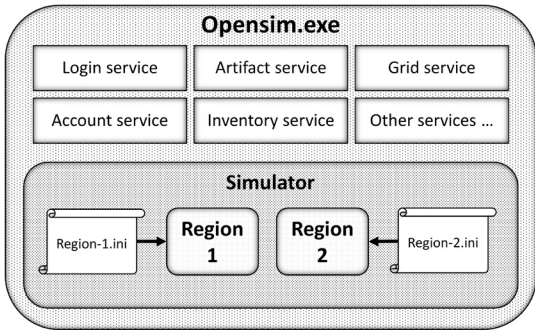
Fig. 1
Standalone configuration with two regions.

The Grid mode works differently. Data services and region simulators are separated into two or more computational processes. In this mode, data services are run by the *Robust.exe* process (*Redesigned OpenSimulator Basic Universal Server Technology – ROBUST*[6]). Region simulators continue to be run by the OpenSim.exe process, but now this process works only for the environment simulation service communicating with data services, running on separate instances (Fig. 2).
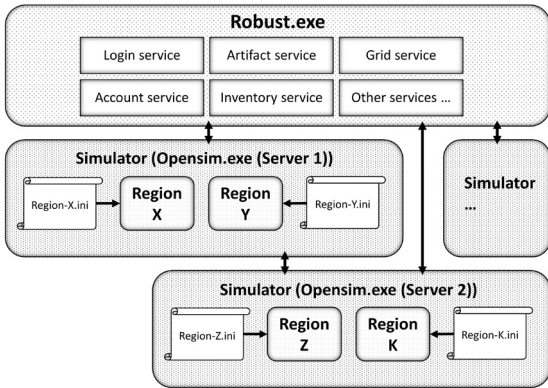

Fig. 2
Grid mode configuration with four regions on two processes.

The reason for having separate processes for regions is that this allows these services to run region simulators (established by users) that connect to other regions, outside the organization, such as public

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[6] http://opensimulator.org/wiki/ROBUST/

Grids, while keeping data processes isolated from external servers. There is a specific protocol for this, called Hypergrid, with its own settings and management aspects to consider (Lopes, 2011).

OpenSim provides a way to manage the installation via the command line, without providing a graphical interface. The administration commands of the OpenSim servers are entered by typing in the terminal executing the process. These are of two types, those that apply to the simulator and those that apply to grid services. In a standalone installation, both run on the same console because the server is unique. In a grid architecture installation, the commands for the services work on the ROBUST server console and the simulator commands on the consoles of the various simulators (separately). The list of these commands can vary with the version of OpenSimulator used and the best way to find out which ones are available is with the "help" command in the region console.

3. AVAILABLE MANAGEMENT TOOLS

As stated in section 1, managing an OpenSim installation can be time-consuming. To ease this, some management tools have been developed by various parties. To identify existing management tools for this evaluation, we have searched for them in the following manner:

1. Querying the GitHub website with the search terms "OpenSimulator", "OpenSim", "OpenSimulator web" and "OpenSim web;

2. Querying the Research Gate website with the search terms "OpenSim", "OpenSimulator" and "managing OpenSim";

3. Browsing the OpenSimulator.org website for info on web interfaces for management.

By resorting to the first method, we have found 2 management systems: OSMW and MWI. By resorting to the second method, we did not encounter any work related to developing an administration tool for OpenSim. By employing the last method, we have encountered a web page with a list of management tools for OpenSim,[7] but only a few could be installed due to deprecation issues: most existing solutions were based on technologies that are either obsolete, deprecated, or the tool was just developed on a much-out-

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[7] http://opensimulator.org/wiki/Webinterface

dated version of those technologies, sometimes as early as 9 years ago. We have attempted to contact the creators of said tools but failed to get support. Given the prevalence of the use of OpenSim, we were a bit surprised by this obsolescence of management tools, but this actually is consistent with the argument that widespread adoption is hindered by lack of adequate management tools (Morgado, 2013). The tools we were able to install and evaluate from this third source were: jOpenSim, Remote Admin, and OpenSimulator WiFi pages. Alongside the ones found at GitHub, these form our analysis batch.

The goal of the evaluation of the management tools was to be able to identify which features were present in each and how would they contribute to minimize the effort of a systems administrator conducting daily tasks. The identification of the features was done by reading the tools' descriptions and documentation (when available, such as for jOpenSim) and by installing and analyzing the web interface of each after we configured it to work with our OpenSim installation.

Next, we present the tools along with a brief description of each. The following section makes a comparison of the features available in these tools.

3.1 REMOTE ADMIN

To access OpenSim remotely, the installation package itself provides the Remote Admin[8] endpoint for the XML-RPC protocol.

Other than providing system administrators with remote access to the OpenSim services specifically (without having to open a remote terminal to the full machine) Remote Admin provides no further support, since its operation is identical to local administration tasks.

3.2 OPEN SIMULATOR MANAGER WEB

Open Simulator Manager Web,[9] or simply OSMW, is a management tool written in PHP that supplies the administrators of OpenSim installations with a web interface that enables user management, exportation of some data lists, monitoring and backup of regions,

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[8] http://opensimulator.org/wiki/RemoteAdmin

[9] https://github.com/Nino85Whitman/OpenSim-Manager-WebV5

and some management of configuration files (table 1). This tool was developed 3 years ago and some of the code needs to be reconstructed due to the changes to PHP consecutively made from version 5.5.29 to version 7.1.14 that deprecated some functions and changed some general semantics in the PHP language.

3.3 MWI

MWI[10] is an open-source web front-end for OpenSim grids, also intended to be a full content management system (CMS).

It has two main parts: a front-end for visitors and an administration area for grid managers, where they can change most of the system characteristics. It provides system administrators with account management, user groups management, and more (table 1).

It is also possible to use it to automate some tasks, such as user registration and password recovery, and to easily access information about the bound regions on the grid.

3.4 OPEN SIMULATOR WiFi PAGES

Wifi pages[11] is a system constituted by a set of components that can be used in both standalone simulators and grid installations to manage OpenSim accounts, updates, passwords and basic aspects of users' inventories. It is said that its properties make it a good fit for small-to-medium OpenSimulator-based virtual worlds. It does not require the installation of a web server since it uses the built-in Open Simulator features.

3.5 jOpenSim WEB INTERFACE

jOpenSim[12] is an extension for Joomla!, a free and open-source CMS,[13] allowing interaction with an OpenSimulator server and 2 modules (grid status and friends online). This component can interact with grid or standalone mode installations, with MySQL as its database engine. Since it is an extension of Joomla!, the rationale is that the administrator can setup a website that suits his needs, design appeal and taste using the features made available by the components and modules provided by jOpenSim. It provides user

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[10] http://mwi.myopengrid.com/page/home

[11] http://opensimulator.org/wiki/Wif

[12] https://www.jopensim.com/jopensim/thecomponent.html

[13] https://www.joomla.org/

management, user groups management, event management, etc.
(table 1).

4. MANAGEMENT TOOLS COMPARISON

As shown in table 1, we can see that three types of features emerge:
the ones we consider basic (features that are available on almost
every studied tool); the ones that are specific to a certain topic,
such as region management, account management, or configura-
tion and administration related features; and features that are only
available on a specific solution.

Some tools have a far more extensive range of features than others.
Comparing OpenSim WiFi pages with other administrative tools
we can see that while it is the only tool that enables inventory im-
port. Beyond that it's the one with the least number of features.

WiFi pages is a very limited management tool since it only provides
features related to account management.

Remote Admin, as mentioned, simply enables administrators to man-
age an OpenSim installation without having to provide full remote
access to a machine (i.e. SSH, Remote Desktop). But it remains the
only way to access a set of region managements features remotely,
that no other tools provide, thus exposing the lack of feature cov-
erage of other tools.

OSMW, along with jOpenSim, is one of the tools with the most features.
The first has the basic set of features present on every tool and
focuses on the maintenance of the installation. It has some unique
features such as the ability to manage non-player characters
(agents that are controlled by the computer, usually called bots
by OpenSim users), save terrain, manage the system's logs and
broadcast a message to all regions. jOpenSim is the only manage-
ment tool that enables the creation of regions, although the other
region-related functionalities are not supported. It was created to
manage a grid, i.e. where each region may have its own adminis-
trator. It also provides the basic functionalities as well as some
unique features such as listing virtual money transactions, event
management and an in-world search that allows managers to find
items within the virtual world.

MWI is one of the two analyzed tools that can manage user groups.
This functionality may not be important for small OpenSim instal-
lations, but for more complex OpenSim grids it is very important,
since groups can be formed by any set of 2 or more avatars. Its
other features are like the ones provided by WiFi pages, and so we
can say that this feature is its only advantage over the latter.

WiFi pages can be used to manage a small OpenSim installation, as
it does not need an HTTP server to work and complements the

administrator commands with a web interface for account management.

The only tool that provides the ability to (or not to) authorize users to access certain parts of the virtual world through a graphical interface is MWI. This feature may be important if there are private sessions occurring somewhere in the virtual space.

With a more thorough analysis on table 1, we can see that the most adequate management tool for an administrator depends on the overall computational and usage environment of the OpenSim installation. For example, if one uses OpenSim only to explore a virtual form of socialization, with a few people connecting to a server, the only functionalities that are maybe needed are being able to create, to edit, and to delete users from the virtual world. If so, WiFi pages are enough to manage this system. On the other hand, if a training corporation or educational institution wants to use an OpenSim installation for training and education purposes, it is likely that none of the management tools explored in this article provides enough features, requiring some of the administrative work to be done at the console.

	REMOTE ADMIN	MANAGER WEB	MWI	WIFI PAGES	JOPENSIM
Remote access to OpenSim	yes	yes	yes	yes	yes
Create users	command line	yes	yes	yes	yes
Edit users	command line	yes	yes	yes	yes
Define default avatar				yes	yes
Export inventory		yes			
Import inventory				yes	
Manage user groups			yes		yes
Region Status	command line	yes	yes	yes	yes
View Map		yes			yes
Create region	command line				yes
Edit regions	command line	yes			
Restart regions	command line				
Get region access list	command line				
Add users to a region's access list	command line				
Remove users from a region's access list	command line				
Save region	command line	yes			
Load region	command line				
Non-player character management		yes			
Save land		yes			
File management		yes			
Log management		yes			
Edit configuration files		yes			
Edit simulators table		yes			
Define home location			yes		yes
Broadcast message to all regions		yes			yes
In-world object search					yes
Define default region			yes	yes	yes
Event management					yes
List money transactions					yes
Terminal management					yes
Get OpenSim version	command line				yes
Teleport agents	command line				

Table 1
Features available in the management tools.

5. CONCLUSIONS

As seen in section 4, none of the analyzed tools provides a superset of all services. There are always missing features in a tool that are available in others, and features that remain available only via the command line. If one considers the list of requirements identified

by Morgado *et al.* (2016), many aren't available at all. So, it is safe to say that there is not a management tool that fulfils the needs for practical organizational management of OpenSim installations. The analyzed tools were likely built with an ad hoc approach, focusing on individual managers' specific needs, and do not reflect an organizational requirements perspective of the management challenges of an OpenSim installation.

We encourage further research on identification and specification of administrative features required of OpenSim management tools, and their subsequent development, towards a more widespread deployment of virtual worlds in education.

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