Second Life: The next virtual laboratory?

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1 Introduction
A virtual world is a computer based environment, typically in three dimensions, where a person can interact and manipulate objects and communicate with others. Users are represented in the virtual world as avatars, although these are typically 'humans', they can have any shape and size. Virtual worlds have been used for a number of applications including research, commerce and education. In this paper we will focus on research-led education.

There have been a number of virtual worlds developed specifically for education, such as Active Worlds Educational Universe (AWEDU)[1], Media Grid[8] and EduSim[5]. Each of these virtual worlds are aimed at different age groups and attempt to simulate different aspects of real world teaching within their environment, such as lectures, demonstrations and group tasks. Virtual worlds can benefit the learning environment as they offer visualisation not available through traditional simulation techniques and can promote discussion among students who are located across the globe.

Second Life[9] has become the most popular of these virtual worlds with over 1.3 million users. Its success has come from its easy to use interface, global media coverage and its free-to-use policy. Second Life also allows, assuming you have the correct permissions, to build objects within its environment and develop scripts to run within them. It is this functionality that is used to develop its educational areas, such as virtual lecture theatres (with streamed media), interactive (and dynamic) models and virtual presentations. Second Life is closely linked to other online information stores, for example links to websites can be given to the user by exhibits as note cards, allowing users to expand the learning experience as they wish.

The Virtual Chemistry Experience (ViCE) project[11], funded by Learning and Teaching Enhancement Unit (LATEU)[10], have generated a number of Second Life exhibits designed to promote teaching of chemistry to a wide range of ages. These exhibits focused mainly on drug docking in protein structures. The Second Life exhibit parallels the e-Malaria[3] web site, developed at the University of Southampton. A potential anti-malaria drug is generated and submitted to docking simulation software through a web interface. A docking score is generate which represents how well the candidate molecule would bind with the dihydrofolate reductase (DHFR) and therefore how good a possible drug candidate it is.

2 Implementation
The e-Malaria project was modified slightly to work with Second Life. Using the web interface, users would use Jmol[7] to build the drug candidate. As this input method is not available within Second Life, the drug design was simplified to a set of building blocks. The available building blocks were limited to the natural amino acids which can be combined to a build a tripeptide. This was made available in Second Life as a 'fruit machine', as shown in Fig.1. The user spins the reels, which randomly selects three amino acids to generate the tripeptide candidate. This is submitted to a web service which generates the docking score. As the exhibits were shown as part of the National Science and Engineering Week...
outreach event[2], the docking scores needed to be available over a very short time scale, to allow this all the tripeptides were run through the e-Malaria system before the event and stored in a database (although the tripeptide could have submitted to the docking simulation software if more time had been available). The web service requests the tripeptide docking data from the results database and returns these back to Second Life, where the user is given their score.

Figure 1: The e-Malaria fruit machine Second Life exhibit

To extend the e-Malaria exhibit a Second Life ‘molecule rezzer’ was generated to render structure data. This object sends a request to a web service containing information on the molecule it is generating. The web service looks up the MOL file for the given molecule and produces a reduced format of this file which is returned to Second Life. The molecule rezzer uses the atom co-ordinates, atom type and bonding information to generate the molecule in Second Life. This was used in the e-Malaria exhibit to generate the tripeptide candidate and docked drug to show the students how the molecules align within the docking site, as shown in Fig.2. This rezzer has also been used to render crystal structures using data from the eCrystals[4] repository at the National Crystallography Service (NCS)[6].

Figure 2: The e-Malaria fruit machine with tripeptide before and after docking

As the e-Malaria exhibit was aimed at students already with a basic understanding of chemistry, a simplified version was built as an introduction to chemistry and protein docking (aimed particularly for younger ages). The concept of drug docking was simplified to a key fitting into a lock - if the key fits, the drug may be successful. This was built in Second Life as a locked chest depicting a sensory receptor and a number of keys linked to a stimulus, as shown in Fig.3. A student attempts to determine which stimulus will effect the given receptor and a good fit will unlock the chest.

3 Discussion and Conclusions

During the National Science and Engineering Week family day the exhibit was used by hundreds of people of all ages, although mainly school-age children. During the event a number of Second Life questionnaire exhibits were run. The feedback from the participants suggested that the use of Second Life as a teaching tool was not only new, but provided an interesting way to present education material.
Observations of the participants suggested the virtual world has an intuitive control system which required little time to establish. The combination of the two exhibits provided a learning experience for users of all ages.

The major drawback during the family day event was from the lack of regular bandwidth, as there were a large number of stalls in a small area there was a slow down when several people were interacting with the exhibits. Currently objects in Second Life are limited to 16Kb of memory per scripts, this can drastically limit what they could be coded to achieve. This can be avoided by following strict guidelines when scripting the objects, such as limiting the use of lists and avoid storage of long strings.

The project is currently expanding to provide more interactive exhibits. Software has been developed to control a second harmonic generation laser experiment using a message broker and control messages. Theses messages can be generated through a call to a web service and therefore can be sent from Second Life, the result plots are also generated from a single URL request so can also displayed in Second Life. The NCS X-ray diffractometer will also linked into Second Life using the messaging software, this can generate a 3D representation of the crystal structure as the results are collected. Several other schools within the University of Southampton (Medicine, Architecture and Education) have also shown interest in building exhibits within Second Life and the project is also working on outreach to schools and support for undergraduate students.

References