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OSCase: A data scheme for transfer of Web based Virtual Patients to OpenSim

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Abstract. Experiential game based learning has proven effective at engaging and enabling learners especially in medical education where the volume of the curriculum is as severe as its criticality. A mature and promising ICT tool for medical education is the Virtual Patient (VP). Web-based virtual patients have been established for quite some time, while efforts have been made to create content in multi user virtual environments (MUVEs). What is still missing is a streamlined method for transferring VPs from Web-based authoring and deployment platforms to MUVEs like OpenSim. This work describes the existing implementation context for repurposing VPs in the OS MUVE. Then it focuses on a novel OpenSim Case Datascheme (OSCase) that facilitates this streamlined transfer according to previous repurposing strategies and efforts. Finally the future directions and the place of this work in the wider context of contemporary Virtual Learning Environments is explored.

Keywords. Virtual Patients, Mutliuser Virtual Environments, OpenSim, OpenLabyrinth, medical education, Content repurposing.

1. Introduction

Massive content increase in medical education [1] as well as the criticality of the subject matter has led contemporary medical education to move into diverse activities and resources that become increasingly digital [2]. The underlying goal of these efforts is ubiquitous access to clinical skill development tools [3]. Web and Information, Communication Technologies, thus, become key enablers in medical education providing the tools for developing interactive, immediate learning environments independent from location and time constraints [4].

A very promising ICT tool for enabling medical education is the Virtual Patient (VP). It has been formally defined by the MedBiquitous Consortium as "interactive computer simulations of real-life clinical scenarios for the purpose of medical training, education, or assessment" [5]. Its importance was immediately identified with efforts being initiated and formalized into an International Standard for exchangeability purposes for several years now [6], [7], [8]. The acceptance of the VP with platforms enabling Web based streamlined development and deployment has facilitated diverse learning episodes and modalities such as lectures, exams, project/problem–based

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learning as well as both synchronous and asynchronous e-learning sessions [9]. VPs' proliferation has led to endeavors of specializing and contextualizing their design models even down to particular medical specialties [10].

This proliferation of VPs led to the development of several VP authoring and deployment platforms. One such, widely spread, platform is OpenLabyrinth (OLab) [11]. OLab is defined in its user guide as "…an open source online activity modelling system that allows users to build interactive 'game-informed' educational activities such as virtual patients, simulations, games, mazes and algorithms. It has been designed to be adaptable and simple to use while retaining a wealth of game-like features." [12]. It is a web based tool that is accessible through most contemporary browsers with minimal hardware requirements and with an acceptable learning curve. This accessibility makes it suitable for deploying content for testing new learner-centered educational approaches.

Advances in presentation with game-like 3d Multi User Virtual Environments (MUVEs) have led to the deployment of VPs in them in order to increase immediacy, impact and the user's sense of presence [13], [14]. A MUVE's definition can be construed as identical to that of Virtual World: "A synchronous, persistent network of people, represented as avatars, facilitated by networked computers" [15]. This definition inherently demonstrates the educational advantages of this platform. Persistent and synchronous networking is a significant collaboration facilitator. The graphical representation of the user in customizable human likeness creates a sense of presence and immersion [14] that is inherently assistive towards engagement in various educational (or not) goals.

This work is based on current achievements in our efforts at repurposing VPs into the OpenSim (OS) MUVE. Having established a streamlined way of presenting individual VPs in this environment as point and click adventure episodes we present here a data scheme to facilitate automation in the repurposing of VPs from the popular OpenLabyrinth (OLab) platform to the OS MUVE platform. The rest of this paper is organized as follows. In the next section we describe the current status of our VP repurposing efforts both within the OLab platform and the lessons learnt from manually repurposing cases from OLab to OS. Based on this context, then, we present the data scheme that will be used to become the link between the OLab data infrastructure and the OS VP deployment mode that we have chosen to implement. In the final section the immediate future steps of this work are explored and the implication in the wider context of medical education research is discussed.

2. Implementing VP repurposing.

2.1. Repurposing Web based VPs in content and context

On one axis the repurposing efforts taken involved the extension of the mEducator metadata scheme [16], [17] in order for it to become applicable in OLab creating its semantically enriched extension, OLabX. This semantic enrichment allows VPs to be discoverable, sharable and searchable for ease of repurposing. OLabX has extended the metadata that describe a VP (Labyrinth) through the existing OLab Global Metadata Editor in order to cater for the provisions in the mEducator schema.

This schema defines metadata accompanying an educational resource, in our case a VP [16]. The metadata are highly structured supporting reusability and repurposing of the resource [17]. Its implementation provides advanced repository functionalities that were not present in the core OLab tool. Contextual content query, with synonym identification as well as rudimentary analytics in the form of past user preferences are the main features that separate OLabX from the core version. Additionally, the open architecture of the scheme through the utilization of existing end established medical vocabularies ensures the extendibility capacities of OLabX through implicit RDF referencing. The details of the OLabX metadata scheme have been extensively described elsewhere [18].

2.2. Repurposing VPs to MUVEs

On a parallel axis the repurposing efforts taken involved the "cross-environment" migration of VPs from the Web to MUVEs. Efforts included both a dental VP [19] and training scenarios for carers of the elderly [20]. While the subject matter was in widely different areas of the overall healthcare field, the technical specifics were the same. The cases were deployed initially in Second Life and then in OS both in the form of a point-and-click adventure. The user feedback came mainly through chat messages. The user guided the action through either multiple choice notecards on which the user had to make one choice or through simple choice of items, by clicking on which, the user declared his intended action as described by the cases' narrative (**Figure 1**)

Figure 1 A multiple choice notecard for receiving the input of the user in OpenSim deployed VP.

In all cases the VP trees were implemented to the OS MUVE verbatim as they were initially deployed in OLab. Constraints such as time limits were removed because the focus was on the assessment of implementation and usability and not so in the efficacy of the case as an evaluation tool. Most of the choices that the player made were narratively evaluated and the user was given the opportunity to retry in order to avoid unnecessary frustration.

Technically, all the VP simulation was implemented through the OpenSim Scripting Language (OSSL). All the appropriate Web resources (eg, images) were stored in a lab server. OSSL is an event/state-based language. Scripting utilizes events, such as clicking, listening for chat messages, or deploying items in the world. Using these events as triggers complex interaction scenarios can be coded. The activities of the case were coded as events that triggered as the user interacted with the environment by touching pieces of it and receiving challenges in the form of multiple-choice questions. The user's response triggered additional events that led the case to move to the next relevant state/node. Additionally, all the patient data, narrative, values, or external media references were stored in the case script as global variables. Each in-world object contained its own script that communicated with the main simulator scripts to facilitate interaction through clicking on objects.

In order for this model to cater for technical limitations (e.g. maximum script file size) as well as following OLab's implementation logic, virtual "nodes" were created in OS too. These are, in-world, invisible and intangible objects, containing scripts that implement all the connectivity logic and present the case's narrative to the user. Communication between these nodes was realized through simple chat message exchange in predetermined chat channels of OS. While the user experienced the case as an interactive point and click adventure clicking at designated points, receiving feedback and making choices, these activities were an interactive navigation of this virtual node tree through clickable objects and multiple choice notecards. All nodes consisted of these two script types and between the nodes of the same type differences existed only in variable values (narrative strings, navigation node id numbers etc). In this way, from a technical point of view, implementation time was reduced and debugging was facilitated. Furthermore this implementation ensured maximum reusability of script assets and also presented the opportunity for implementing a data scheme for automated deployment of OLab VPs in OS.

2.3. The OSCase Datascheme

In the previous section the repurposing of VPs from the web to the MUVE have been described to provide context to the effort being made currently to automate the transfer and linking of OLab resources to the OS MUVE.

The overall approach of the OS Case Datascheme is outlined in **Figure 2**. Each OS Geometry Object is defined as the actual graphical asset, e.g. a house, a chair, etc as depicted in-world. This becomes part of the OS Asset Repurposing Archive and is assigned, through the OS Object datascheme the necessary attributes for unique identification. These include the URL of the Grid in which it belongs, its unique in world identifier – OS - UUID, OS Grid geometry localization (where it is and it's dimensions) as well as a designated channel that will be used for communication with this asset. Geometry Objects are distinguished between Assets and Environments in order to establish a basic hierarchy (e.g. a piece of Furniture is an asset that belongs to the Environment "Beach house") that can be used by content creators for meaningfully interpreting relationships between Assets. For example, if a user was to repurpose a VP and choose as environment a "Doctor's Office" there should be clarity about which assets of the database are technically in the same OSGrid and, thus, physically within the environment.

This OS Object datascheme is incorporated to the overall OS Case datascheme which also links to OLab's datascheme in order to facilitate the assignment of meaningful state/link pairings to each instance of use for each OS Asset that is utilized in the repurposing effort. Each of the significant entity types in OpenLabyrinth has its equivalent in OS. For this purpose, the data scheme includes classes like Labyrinth, Node and Link, which represent the same structure found in the original virtual patient. The mapping between the OpenLabyrinth entities and the OS Assets is realized through a set of interaction-related classes.

NodeNavigation is a wrapper around Node. An instance of this class is created every time the user navigates to a new node by following a link. The NodeNavigation instance is followed by an InteractionTriggerCollection which represents the outgoing links of the current node, introducing interactivity. Depending on the semantic properties embedded into the node, the InteractionTriggerCollection instance is implemented either as a NoteCardOptionCollection or a LinkBoxCollection to address the scripting implementation of either Notecard or clickable objects' nodes. The former is attached to an OS asset that triggers it and is followed by many NoteCardOption instances to show as message options in the OS Notecard. LinkBoxCollection, on the other hand is not attached to a specific asset, as it is followed by LinkBoxes that each is attached to the relative triggering asset (OS Clickable object). Both LinkBox and NoteCardOption can be seen as parts of an interaction setting where they are expressing the multiple navigation paths available starting from a labyrinth node. All communications between the MUVE and the web infrastructure shall be realized in JSON format.

The detailed description of the OSCase datascheme in UML is presented in **Figure 3** -**Figure 5**.

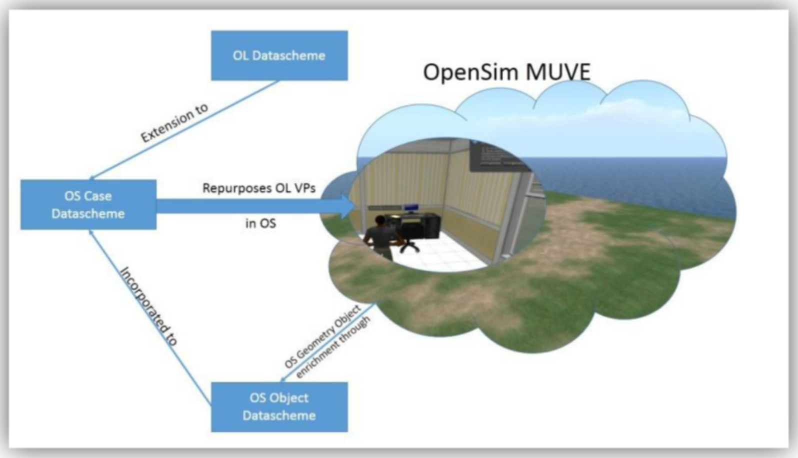

Figure 2 The overall approach of the repurposing effort from OLab to OS.

3. Discussion

The work presented here describes a datascheme that can readily be utilized for repurposing OLab deployed VPs in the OS MUVE. Efforts are currently directed in implementing a web based front-end for content authors to be able, through it, to rapidly repurpose VPs into the OS MUVE. Immediate steps after implementation include both usability and efficacy testing of this repurposing framework.

In online education the phrase Virtual Learning Environment (VLE) has changed meaning significantly. From the closed online repositories where instructors uploaded their content on strict access terms, to the world of today's MOOCs [21] VLEs are now envisioned as collaborative, decentralized, educational activity signposts that guide, albeit expertly, the participant to find appropriate content for organically achieving specific learning objectives. Content is delivered by an online infrastructure of tools [22] that is also decentralized and utilizes cloud computing [23]. Students are expected to participate in a MOOC as active collaborators. While the educational process may begin in the central MOOC hub, the core of collaborative educational action may shift to a student's personal blog or youtube channel [21].

A

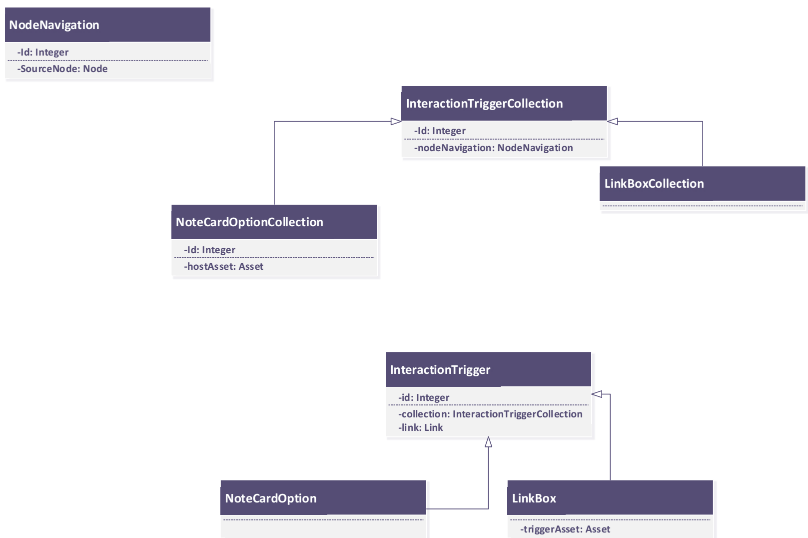

Figure 3 OS Case Datascheme A: The Relationships of the proposed datascheme.

B

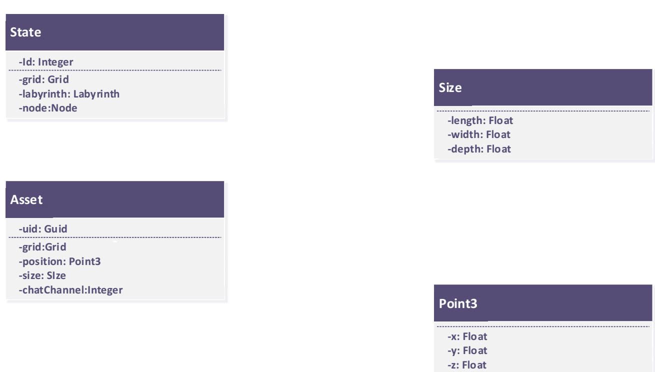

Figure 4 OS Case Datascheme. B: OpenSim side Description.

This paradigm of decentralization aligns well with the repurposing effort presented in this work. With the immersion potential, the capacity for collaboration and engagement of MUVEs as a given [13], [14], the inclusion of this educational medium in Massive Open Online educational endeavors appears as a natural evolution. The main barriers to such an evolution are the integration to the infrastructure and the creation of a non-trivial amount of quality content in this medium. However, with the aforementioned decentralization of the infrastructure, the integration problem becomes less important. With VPs as an implementation being around for almost 40 years [24] and OLab almost reaching a decade of existence [11] web based VPs can be considered a mainstream tool in medical education. Hence streamlining transfer of such cases to a MUVE can provide a significant content boost in MUVE VPs.

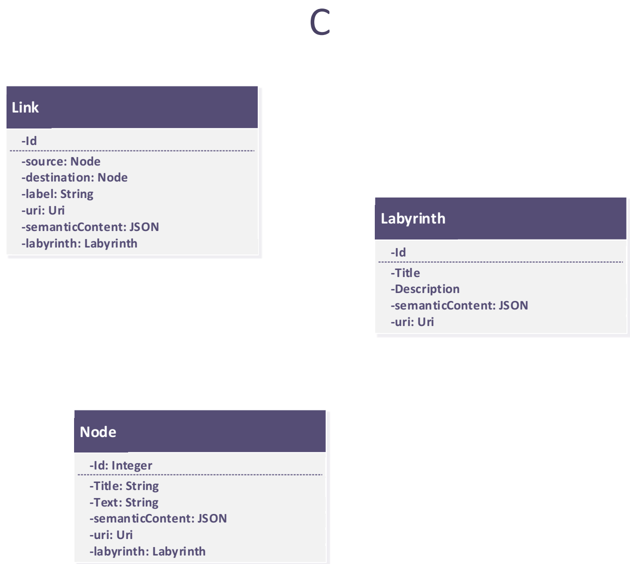

Figure 5 OS Case Datascheme. C: OLab-side inclusions.

This work is the first step towards streamlined repurposing of VPs into MUVEs and integrating this medium in the overall endeavor of contemporary VLEs. The feasibility of deploying web based VPs in VLEs such as MOOCs has been explored with promising results [25], [26]. While transparent accessibility of a MUVE through a web interface is still an issue, a more important issue is addressed by the current work, that is, rapid content development in the MUVE platform. The datascheme presented here aims to contribute in the evolution of that aspect of contemporary VLEs.

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