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Multi-User 3D Virtual Environment for Spanish Learning

A Wonderland Experience

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Abstract— In this paper, we describe a 3D virtual collaborative system designed for the learning of Spanish as a second language. Several initiatives for second language learning in 3D virtual worlds exploiting immersive, interactive and motivating features of these worlds have been carried out successfully during the last years. However, these systems tend to be sometimes too rigid from a pedagogical point of view, requiring the presence of a teacher. We have used the Wonderland development toolkit to deploy a 3D virtual learning environment, which is flexible enough to allow learners to improve their language skills with minimum teacher's help, setting up an instructional sequence in which fostered, motivating, and pre-designed collaboration is the key for self-learning. The environment includes technical issues such as natural text chatting with synthetic characters, textual tagging of virtual objects, automatic reading of texts, and the integration of a 3D mouse in learning sequences in order to exploit the capabilities of 3D virtual worlds.

Keywords—3D virtual learning environment; learning system architecture; technology-enhanced language learning.

I. INTRODUCTION

The best way to learn a foreign language is to be exposed to real situations in which it must be used to communicate. This is not always possible for logistical reasons and even when this is feasible, the lack of instructional design during the interactions may slow down the learning process, making it somewhat chaotic and without a clear aim. A sound alternative to get the required level of linguistic immersion in terms of time and without losing control over the learning process are 3D virtual environments. A 3D virtual world provides a shared, realistic, and immersive space where users, by means of their avatars can explore, interact, and modify the world, in addition to communicate and collaborate with other users in both synchronous and asynchronous ways. These 3D collaborative worlds offer a rich environment in which learners can strongly interact with each other, increasing student's motivations for language learning, and making things easier for more timid students.

Our project was born with the aim of taking full advantage of 3D virtual environments, when used to learn Spanish as a second language, allowing students to engage in highly motivating lifelike cultural situations, while at the same time practice the traditional four skills to be developed when learning a foreign language: reading, writing, listening, and speaking. These four skills can be adequately

orchestrated under a didactical design specifically adapted to the 3D environment. Not only does this involve analyzing and exploring the most distinctive features of these environments, looking for new approaches for their use in language learning, but also to find new ways of enriching them from a technological point of view, programming new learning tools to be added to the 3D platforms in use in order to increase the interactive and collaborative capabilities of the learning system.

Under this general idea, our project conceives the 3D learning system as a whole, as an integrated set of technological and pedagogical issues that are tightly related to one another, having to be dealt with independently, but under a unifying light. This dual nature of our work will be reflected in this paper, in which we will describe both, the didactical developments as conceived in the first place (in section II) and how they eventually have been brought into life by means of existing 3D technologies enhanced with our own developments (section III).

II. INSTRUCTIONAL DESIGN

A community of students experience auditory and visual immersion in a synthetic environment that imitates cultural sights of Madrid. The virtual scenario provides a framework to immersive experiences that could represent real situations for a tourist in the city of Madrid, and helps students to acquire the desired learning skills. Students represented by customized avatars of their choice, can explore freely the three environments to achieve a final goal: to get access to The Prado Museum. This follows the situated learning approach developed at [1], where there is a strong relationship among people and a strong connection between knowledge and activities.

The 3D virtual scenario is filled with information and activities designed to stimulate an inductive reasoning. Students explore the 3D virtual world aiming to acquire the vocabulary and language patterns related to the unit of study that they are expected to learn.

The information in the 3D virtual world is distributed through text, audio, graphic in synchronous and asynchronous ways via scenario, objects, synthetic characters or representation [2] of humans in the virtual world. Technical elements used in video-games such as small-map to aid in orientation, cursor indication to show objects with extra information and non-player characters performing dialogs are also employed in our 3D virtual environment. Information attached to objects gives introductory

knowledge to students while advanced knowledge transmission is done through dialogs among synthetic characters.

All the students can discover the same vocabulary and language patterns, but not all them receive the same information. Nevertheless, to pass the final assessment, students should know all the information, thus they have to communicate with each other in order to get it. This is a collaborative process that is guided for a goal and it is the final stage of knowledge acquisition: expertise.

The activities needed to develop and practice the skills involved in learning a foreign language are reading, writing, listening and speaking. In our 3D learning scenario, the activities are structured as the interaction of avatars with 3D elements: synthetic environment, smart objects, non-player characters (NPCs) and other avatars.

Reading skills are promoted through information associated with 3D objects included in the scenario.

Listening skills are encouraged through different techniques. The simplest is to exploit the reaction capabilities of objects in the 3D scenario. Students can also listen pre-recorded conversations between NPCs. Simple conversations allow illustrating the use of grammar patterns and more complex conversations, related to cultural aspects of the lesson topic, allow the development of more advanced listening skills.

The students will develop basic writing skills using the vocabulary and grammar of the lesson to ask and give information to non-player characters that understand simple constructions.

The activities previously described are achieved primarily through the exploration of the virtual environment; speaking skills are promoted through collaborative activities that force avatars to talk to each other.

III. ARCHITECTURE

We have built our 3D virtual learning environment with Wonderland [3], a cross-platform, free, open source, and distributed client-server architecture. We have extended its functionality by plugging in several modules required in our learning environment (see Fig. 1).

A. Wonderland Server

In Wonderland, the graphical objects must be in the COLLADA [4] format and are stored as XML files. We use the application Google SketchUp [5] to create (or import) the 3D models required.

The sound spatial capabilities are provided by its Audio Engine and are particularly relevant for our Spanish learning environment, because they provide a full audio immersion. Audio immersion is achieved by attaching each audio fragment to a point in the 3D scene. The point can be for instance an NPC. When the student's avatar approaches that point he/she can hear the sound louder.

The audio fragments for the NPC conversations were obtained using the Text To Speech (TTS) technology, but could have been also audio recordings spoken by a person. TTS was chosen, because it provides an acceptable quality

and automates the production. The audio files were created with TTSReader [6] freeware software.

A key aspect of our instructional design is the social interaction among students; this is guided by grouping them in small units managed by the Group Management plug in.

Finally, each learning sequence takes place in a scene and when the learning goals have been achieved, the avatar may be teleported to another learning sequence. This is done by the Portal Engine.

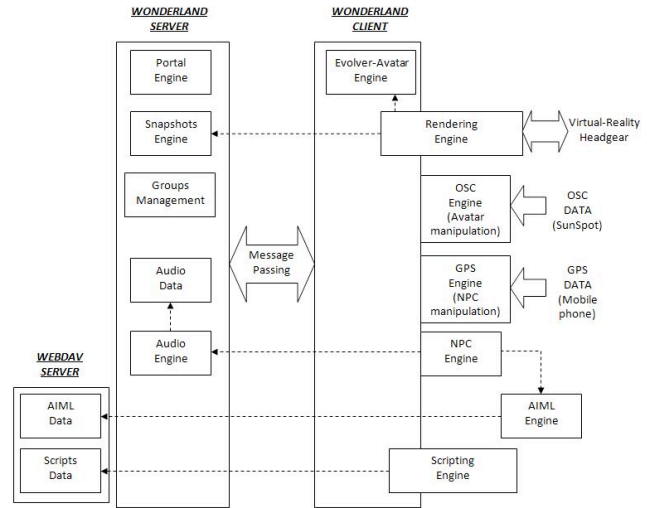


Figure 1: Architecture design

B. Wonderland Client

We have extended Wonderland's Rendering Engine to provide visual immersion through the integration of a virtual-reality headgear as display.

As avatars are the users' representation in the virtual world, it is crucial that learners customize their avatars according to their preferences. Wonderland 0.5 provides limited capabilities at this respect, thus we suggest using the Evolver 3D Avatar Generator [7] to create avatars.

To ease the movement of avatars in the virtual world, we have developed the OSC Engine, an avatar manipulation engine that allows students to move their avatars through a SunSPOT device [8]¹, besides the keyboard and the mouse.

Our platform was customized programming object behaviours as a reaction to mouse and key events. In this regard, the shape of the cursor changes when the mouse is over an object with information for the learner and text appears once the student clicks on a smart object. The changes made to the Scripting Engine promote reading skills and help students acquire vocabulary.

We distinguish between two types of characters controlled by our learning engine: NPCs and chatbots. The first are synthetic characters, which drive cyclical story lines that perform dialogues depending on the student who

¹ A video demonstration is available in <http://www.youtube.com/watch?v=kzd0AOHHiiig>

approaches them. The last are used to transmit information to the students by simulating conversations of typical Spanish people. Chatbots encourage students to approach them when their avatars are in their surroundings. Once done, chatbots perform interactive dialogues with students. These behaviours contribute to the acquisition of listening and writing skills in our Spanish learning environment. ProgramD [9], an extended open source AIML platform, was used to program the chatbots. As AIML (Artificial Intelligence Mark-up Language) is an XML-based programming language, it was necessary to store linguistic patterns and their possible answers related to the learning topic.

Finally, a GPS Engine was developed to manipulate NPCs with a mobile phone with Symbian Operating System as an external device. The mobile phone uses GPS technology to detect movement and send the NPC's new position to the GPS client's module via a socket. In the future, we intend to use this technology to move the user's avatar.

C. WebDav Server

Data common to all clients are stored in a WebDav-based content repository hosted by the Wonderland Server. With this content repository, the client can access these data via the HTTP protocol.

AIML data and Script data needed by the AIML Engine and the Scripting Engine respectively are stored in the content repository. AIML data are the XML files that hold patterns that can be introduced by clients along with their associated answers. The Script data are JavaScript files holding the behaviour associated with keyboard and mouse events.

IV. CONCLUSIONS AND FUTURE WORK

3D collaborative virtual worlds open the door to a new way of learning. Setting up realistic environments enhanced with a powerful set of learning oriented tools, these platforms allow for the implementation of sophisticated instructional models within a framework of richer information and cooperation.

In this paper we intended to take a step forward in the deployment of 3D virtual learning environments that fully exploit the immersive, interactive, and collaborative possibilities of 3D virtual worlds. Technical and pedagogical features enrich our environments to provide students with formal and informal learning following less rigid curricula where a teacher is not always present. From the technical point of view, we included cross reality features, the use of haptic devices and natural chatting with NPCs. From the pedagogical point of view, we provide a collaborative environment, where students will acquire and practice the listening, speaking, reading and writing skills under the principles of a careful instructional design.

Our plan is to implement some experiments in order to get feedback from users. Until now we have been integrating a wealth of different technologies and adding

functionality. This integration effort, we believe, is already worth reporting, together with the choices taken.

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² España Virtual es un proyecto de I+D, subvencionado por el CDTI dentro del programa Ingenio 2010, orientado a la definición de la arquitectura, protocolos y estándares del futuro Internet 3D, con un foco especial en lo relativo a visualización 3D, inmersión en mundos virtuales, interacción entre usuarios y a la introducción de aspectos semánticos, sin dejar de lado el estudio y maduración de las tecnologías para el procesamiento masivo y almacenamiento de datos geográficos. Con una duración de cuatro años, el proyecto está liderado por DEIMOS Space y cuenta con la participación del Centro Nacional de Información Geográfica (IGN/CNIG), Grid Systems, Indra Espacio, GeoVirtual, Andromeda Ibérica, GeoSpatiumLab, DNX y una decena de prestigiosos centros de investigación y universidades nacionales."