Collaborative Web Platform for Rich Media Educational Material Creation

I. Alberdi, H. Iribas, A. Martin, N. Aginako

***Abstract*—**This paper describes a platform that faces the main research areas for e-learning educational contents. Reusability tackles the possibility to use contents in different courses reducing costs and exploiting available data from repositories. In our approach the production of educational material is based on templates to reuse learning objects. In terms of interoperability the main challenge lays on reaching the audience through different platforms. E-learning solution must track social consumption evolution where nowadays lots of multimedia contents are accessed through the social networks. Our work faces it by implementing a platform for generation of multimedia presentations focused on the new paradigm related to social media. The system produces videos-courses on top of web standard SMIL (Synchronized Multimedia Integration Language) ready to be published and shared. Regarding interfaces it is mandatory to satisfy user needs and ease communication. To overcome it the platform deploys virtual teachers that provide natural interfaces while multimodal features remove barriers to pupils with disabilities.

***Keywords*—**Collaborative, multimedia e-learning, reusability, SMIL, virtual teacher

I. Introduction

E-LEARNING, also called web-based learning or online learning, is presented as one of the formative strategies that most efficiently can solve many educational problems we face. Problems like the student's geographic isolation from the centers of knowledge or the need for continuous improvement that the knowledge society requires. Furthermore, e-learning can lead to lower economic and time cost. Thanks to these two main reasons this type of educations is becoming an important alternative to classroom learning. Getting into the subject we can see that there are two e-learning types, synchronous and asynchronous:

For Synchronous e-learning, teachers and remote students are simultaneously in the learning event. Hence, this event happens in real-time.

On the contrary, asynchronous e-learning does not require simultaneous participation of learners and instructors but refers to a situation in which a learning event does not take place in real-time. Teachers create learning lessons and publish them in the web, so that the students could accede to it whenever they can.

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This type of e-learning is the purpose of the project because it is more open learning than synchronous and represents more clearly the main intention of time saving and flexibility for students. In the learning process the most effective learning technique is immersive learning. To get an immersive environment there are different options, one of them is animated characters [1]. The characters and their voice, content and appearance create an experience that both engages and enhances the learning process.

In a world where the education is given by different teachers, it is very important to blend in a broad platform the possibility of working in groups. Moreover, a collaborative work enriches the content of the courses [2]. That is why this project has promoted two different working contexts, the individual work by the edition application to create atomic material, where the cooperation management could exceed development effort, and the work in groups by the server platform performed by the collaborative editor to generate higher pedagogical level outline.

Why reinvent the wheel again? For most professionals, this question summarizes perfectly the importance of reusability. In a society where most people are running everywhere and people is in a hurry for all, it is very important to save time. In our context, the creation of e-learning video-courses, the simplest way for that is the reusability of previously created materials and templates into new ones. For example, the content made one year could be updated for the next one, a part of it can be useful for the creation of a new material or a template of a course can be useful for another.

This paper proposes a collaborative platform for the creation and edition of videos for asynchronous e-learning courses. It also has certain properties that permit the reuse of multimedia contents and the possibility of inserting a virtual teacher that helps the student have a more inmersive learning experience. Moreover, a really simple and intuitive user interface has been created because most of the people that will use the platform could not be experts in video edition. The editor is based on standard SMIL templates, defined as xml files with time descriptions, that can be exported to different standard multimedia file types such as avi, mpeg or flv, ready to be published and shared on the web.

The rest of the paper is organized as follows. In section II there are some innovative learning features that we present in this paper. After, in section III there is a brief explanation of the new technologies used for the development of the platform and reasons for its utilization. Then, section IV explains the architecture and the two applications of the platform. Finally, in section V there are conclusions of the work made and possible future works.

II. Innovative Learning Features

The quality of the learning experience is continually validated and evaluated to enhance it according to new designs and contents that track two main aspects. On the one hand, new cognitive models, from studies in cognitive neuroscience and psychology [7], drive human cognition applications to the need of natural communication and human interfaces that hide the ever-increasing complexity of today's systems and devices. On the other hand, social evolutions that drive content consumption to multimedia formats. The platform described in this paper leverage educational material creation exploiting new possibilities provided by technologies already deployed successfully in other areas. These are related to the social media and the new paradigms of interaction and creation. In parallel the system faces the authoring process itself in order to boost creative activities by means of template mechanisms driven through reusability strategies. On top of these, the solution provides a virtual character or guiding tutor of created contents in order to engage user cognitive processes in terms of paying attention with friendly interlocutor interface.

The main skills of the described approach, in contrast to other available solutions in collaborative multimedia research in e-learning, lays on: a higher flexible creative layout definition capabilities [8]; simpler and more intuitive interfaces to build educational material focused in learning objects management [9], [10], [11]; and virtual character features and collaborative creation possibilities [12].

In the next sections the different features provided by the solution are depicted highlighting the intended enhancements in terms of education skills.

A. Reusability

Considering the time and effort expended by experts to create content, reusability is a main challenge related to multimedia education contents in order to reduce overall costs associated to design and creation activities.

Learning objects face it. E-learning contents can be scheduled as individual learning objects, labeled and stored for reuse in a wide variety of learning contexts in contrast to other educational materials. These learning objects can be assembled into different schemes depending on the individual educational situation and pedagogical target.

The main features to achieve reusability of learning objects include:

1) Self-contained. This means no third contents or documents are needed to learn the tackled topic.
2) Context-free. The learning object has a meaningful structure independent of higher pedagogical order.
3) Objective-based. It accomplishes just a single learning objective.

This way, learning objects provides portable, independent and reusable learning experiences. However, our approach also addresses side aspects, in terms of accessibility and interoperability of the educational content, by focusing on multimedia creation. Multimedia nature can be exploited to easily deliver courses through the social media networks that widen the audience due to their increasing popularity.

To be more specific the approach described in this paper overcome the reusability need by providing multimedia material design into templates in order to speed up the creation process by minimizing time and effort spent on creating courses. A template don't fit every course but it provides a flexible framework for content that can be built once and reused and adapted for many materials where the pattern provided by the template can be used as a guide to create a learning object. This multimedia authoring strategy has been widely deployed successfully in other areas, like web design. The main concept here lays on the separation of form from content in order to increase reusability and ease sharing and updating information.

The benefits of using templates increase if they are defined according a standard. The standard compliance eases interoperability with other solutions or platforms. Hence, the developed solution lay on top of a web standard for multimedia focusing on the publication in order to reach the audience, e.g. through social media sharing paradigms, in contrast to SCORM (Shareable Content Object Reference Model) compliant solutions [6], [14] that put learning objects indexing at the heart of the systems for reutilization on LMS (Learning Management Systems). SCORM-compliant asset model is over-simplified. SCORM only defines a few asset types, while W3C's (World Wide Web Consortium) declarative-style SMIL is much more flexible in terms of range of managed multimedia objects and scheduling possibilities [13].

B. Collaborative Creation

Educational material, specially in e-learning, can include multimedia contents such as images, sounds, texts and videos from huge multimedia databases already available over the Internet giving the possibility to coordinate and construct rich multimedia presentations that fit better the audience needs and explain better the target knowledge. So the importance of multimedia for learning purposes is unquestionable.

Educational multimedia content creation is an essential skill for today's teachers. Unfortunately, managing creative activities is very labor-intensive. Moreover, creative processes require the coordination of multiple perspectives (content and audience). In order to diminish the related complexity and to increase the quality of the content, the production process is often achieved according to a cooperative process through a team of teachers. Educational content authoring needs teachers and educators combining contributions in order to achieve a workflow definition according to a defined didactic style, educational and pedagogical strategies, and appropriate content selection that consider the learning goals.

Here the solution described in this paper foster collaboration in e-learning environments. A group of teachers can work together to define, design and create educational contents over an underlying computer infrastructure. The workflow technology, which specifies composition of spatial and temporal relationships between objects, is used to provide the group management. This technology overcomes synchronization and activity awareness of the individuals

context with respect to the group's goals and progress. To achieve it the developed web service provides by means of a simple interface a tool to schedule the available learning objects among other teachers to build the educational material and generate the resulting multimedia file.

C. Virtual Teacher

Simplicity is much needed to get knowledge consolidation on the pupil, but achieving it is a grand challenge. Here, a virtual teacher can provide the necessary natural interaction to ease human cognition.

The virtual character that represents the teacher is not just a content support in terms of navigation but a cognitive tool [15]. This way, he is also responsible of keeping pupil attention and maximizing his motivation to learn. Furthermore, the learning environment must be adapted to the different learning styles and educational needs. This includes natural and customized interfaces to meet unique learner needs, and dynamically create appropriate learning contexts. To achieve it, the visual aspect of the virtual teacher should be personalized to the target audience preferences. In our solution this means character selection of a funnier robot character for kids learning science topics or more serious characters for older pupils for example.

Speech is the most natural communication means of human interaction. With the exponential growth and significant progress in available speech technologies, spoken systems have been successfully applied to several domains and educational applications are suitable environments. The speaking capability of the virtual teacher keeps simple information transfer and widens audience easing the specific designed teaching for pupils with visual functional diversity. Moreover, the availability of different languages for the virtual teacher voice eases the material preparation for diverse pupils removing language barriers. Furthermore the text employed for the speech can be used as subtitles to highlight relevant concepts or to enable pupils with auditory functional diversity.

Furthermore, regarding different characters different voices including male and female ones can be used to track character appearance.

III. Technologies

There are four main technologies that have been used for the creation of this platform:

A. SMIL 3.0

The standard of W3C SMIL 3.0 was developed to bring interactive multimedia presentation level to the web and mobile devices. SMIL is based in XML and its syntax describes multimedia presentations (elements duration, order, position, ...) and it can be interpreted and play out by some of the most important media players such as Real Player, Totem, QuickTime and Windows Media Player ([3],[4]). This interoperable feature makes the thin SMIL document itself playable through a web browser.

This language has been selected because of the advantages that provides to this project, particularly because it can be used to reuse content and work on them collaboratively. SMIL can provide meta-information about multimedia presentations. This embedded semantic data can describe the contents in different levels, from high pedagogical tags to specific context of multimedia elements. The higher abstraction level is related to the general learning object for indexing purposes, in a similar way that SCORM does. The lower one contains information about content that has been referenced by a presentation and specifies how multimedia elements (video, text, images) can be presented and played in sequence/ parallel as part of a presentation. The higher one enables reusability of learning objects, while the lower is more focused on life cycle, rapid updating and adaptation.

Moreover, template definition on top of a web standard not only allows the full integration of created contents into any existing web browser but also ensures the stability and future development for the application.

B. Virtual Character

Several studies have shown that the use of a virtual character in e-learning courses facilitates social interaction with the machine and convert the system more reliable and credible for the student. So, it increases the commitment of the student, because it is able to focuses and catches the attention of the student.

The virtual character can be separated in two parts, the graphic side and the voice side.

We have used Loquendo technologies for the voice of the virtual character. Loquendo TTS (Text To Speech) is speech synthesis software able to read any text naturally and expressively. Just giving the text, it is able to reproduce it or to create an audio file and a phonetic file used to produce lip moves.

For the visual side, the virtual character is a 3D model stored as an "obj" standard object. Different designed objs with associated textures have been created using common 3D modeling applications.

It has been decided to use this kind of technology because through OpenSceneGraph could mix the audio file, the phonetic file and the ".obj" file in a video file that integrates all the features (the speech audio, the lips movement and the character appearance) that needed a virtual character.

C. SOA

SOA (Service Oriented Architecture) pushes the application functionality and publishes it to the Internet in a reliable, highly available, scalable, flexible and manageable solution to create and access multimedia learning material [5]. This way, applications turn on services provided on the top of standard transfer protocols over the internet [6] such as XML-based specification SOAP (Simple Object Access Protocol), UDDI (Universal Description, Discovery and Integration), and WSDL (Web Service Description Language). These technologies combined with AJAX (Asynchronous JavaScript and XML) can perform interface or information updates without direct user interaction. This way team activity awareness is achieved, while Flash, employed to create

interactive web and rich Internet applications, establishes the base technologies for our developed platform allowing collaborative authoring and manipulation of multimedia documents.

D.GStreamer

GStreamer is an open source cross-platform multimedia framework written in C programming language. GStreamer can create multimedia applications, and allows a programmer to create a variety of media-handling components, including simple audio playback, audio and video playback, recording, streaming and editing.

IV. Authoring Tool

The authoring tool to create learning objects has been designed as a video editor adapted to e-learning needs. This video editor is divided in two parts. On the one hand, we have the usual editor that permits the mix of audios, videos, texts, images and avatars in the easiest way possible for the video-lessons creators. On the other hand, the collaborative editor permits the reuse of old video templates and videos templates that other collaborators made, and the blend of them for creation of new material. Once the video lesson is finished, the system permits user to save the description of the video in a SMIL file and export in different video formats. The SMIL file is an xml template that can be reuse all the times that user needs because it has the scheme definition of all the elements involved. But the exported videos cannot be reuse because they are just multimedia files.

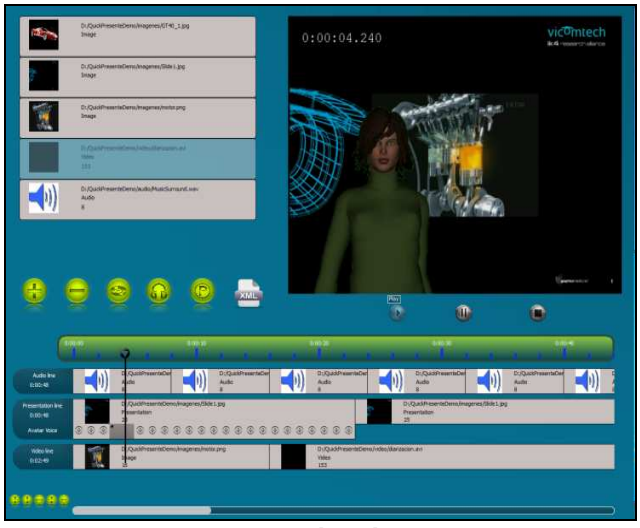

Fig. 1 Video Editor

The main intention of creating this editor was to create a simple and easy handling tool that could use any user without knowledge of video edition.

The whole editor, as can be seen in Fig.1, has three main areas structure. On the right there is a preview and options area, on the left there is an elements list with the buttons for the manipulation of them and bellow those areas, there is an edition area with the buttons that are necessary for it.

A. Elements List

On the top-left side of the interface there is a list of elements with the content library that will be used for the creation of the video-lesson. Here will appear, in order of selection, all the elements that will be use. With the below buttons we can add and remove elements, with the buttons plus and minus respectively, to the list so that the user could use them in the edition.

B. Preview and Options Area

On the top-right side of the interface there is a rectangle which users could use to see the preview of the video-lesson that creates or for the definition of different options. Once the teacher creates and saves the project, he can reproduce, pause and play the preview of the video-lesson using the buttons below the rectangle. This preview is performed by the gstreamer core technology reading the generated template and rendering the resulting video.

The option areas define different parameters, for example if user uses mini-images inside the video, we can define the size and the place where are going. Or in case we use texts we can define the size, the color, the font family ... Furthermore, in this area we can also define options of the avatar and the text that it will say during the speech.

Also, in videos and audio elements, it can be defined the volume of each elements because it is relevant to keep the possibility of adapting the volume to the needs of the user. In edition, when several audio elements are collocated in the same time period, such as a conversation video and an audio file, it is important to reduce the volume of the audio file so the conversation can be heard more clearly or vice versa.

C. Edition Lists

In the video editor there are three elements lists, in the first list are audio elements, in the second list are background elements and the speeches of avatars and in the third list lessons main elements.

The user can manage intuitively all the elements; add, erase and change elements position and duration with the buttons placed at the bottom of the interface. It is so easy to use that e.g. if the user wants to add an element to any list, the system identifies the type of the element and adds to the corresponding list, if it is an audio element it adds in the first list while if it is a video or an image the user just has to define if he wants to add it as a background element or as a main element of the learning object.

D. Edition in Collaborative Web Editor

SMIL has different tags for the definition of timing process and the most important for our collaborative system is <par> and <sec> tags.

The elements inside the tag <par> are reproduced all in parallel being grouped to support complementary pedagogical information. The tag <sec> permits the reproduction of elements in sequence enabling sequential outline construction. It is really important because permits to reproduce an element after other without an explicit definition of the start time. The system knows that as soon as one element ends next one must

start, maintaining the established order. The user just has to define the order of the elements and when saves it, the system takes the information of the different files and saves in a resultant file.

Fig. 2 Collaborative Web Editor

In the collaborative editor there are two main areas, as is depicted in the Fig. 2. On top of the interface, a list of elements previously filtered according to semantic keywords matched with embedded metadata from SMIL documents. On the bottom, an ordered list of elements appears representing the scheduled outline by the team to achieve the target lesson or course. The available elements are learning objects, where they are represented like a single content instead of the set of multimedia elements involved. This way this editor manages a higher pedagogical order driven to educational targets and roadmap.

To sum up, according to the strategy of keeping the developed platform simple, experts can create learning objects through defining new multimedia templates or modifying existing ones through a desktop editor application described before. Afterwards the created learning objects are pushed automatically to the server. Last but not least, the web service provides an intuitive interface to schedule among other teachers the available learning objects to build the lesson or course and generate the resulting multimedia file that can be downloaded and it is directly published online.

V. Conclusion

This paper presents a web platform that helps teachers creating and sharing videos, presentations and audios materials for asynchronous e-learning courses. With this system, different professors that teach the same subject can create files in a collaborative way where each teacher provides the part of the matter that is responsible for and then integrate all pieces in a resulting file, creating it as a team. It makes the resulting video much more rich than just with one creator perspective.

Another strong point of the system is the reusability of the files. Thanks to the template strategy employed by the platform, a teacher can not only reuse a material that has been created about a subject for a concrete student or for another presentation, but also update it easily or format different contents with the same structure to provide a homogeneous outline and corporative image.

The platform manages two levels of abstraction. One in terms of learning objects that lets reusability for design new courses or lessons by composing high level pedagogical topics. Other template-centered, representing inner outline of the learning object, that lets the user to reuse both the pedagogical outline and updating inner elements of a learning object.

Also it is important that the web platform has been developed based in a standard, what makes reachable from all browsers and that gives facilities for the possibility of future developments.

Furthermore, one of the skills that differentiates this application from others is the possibility of inserting virtual characters to support explanations, highlight concepts, or just for give helping advices to students. It is really important because it makes materials more naturals and provides new features to those contents that enrich the teaching system.

In the early future, we want to insert and integrate all the work made in an e-learning real scenario. A place where teachers could share more information and activities in different files-types (texts, audios, images, videos,...) related with the subject and measure the impact of the published materials in the social networks.

Acknowledgment

Thanks to the Basque Government for funding the project where these results are developed.

References

[1] The Use of Characters in e-Learning, eidoserve. http://www.getabby.com/docs/ELearning.pdf
[2] Sung ,M.Y., Lee D.H., “A Collaborative Multimedia Authoring System”, *Lecture Notes in Computer Science*, Volume 3033/2004, pp.311-318, 2004.
[3] Synchronized Multimedia Integration Language (SMIL 3.0) W3C Working Draft 2008. http://www.w3.org/TR/SMIL/
[4] Dick C. A. Bulterman, Lloyd Rutledge. SMIL 3.0 Flexible Multimedia for Web, Mobile Devides and Daisy Talking Books. Springer, 2009.
[5] Chung C. Chang, Kou-Chan Hsiao, "A SOA-Based e-Learning System for Teaching Fundamental Information Management Courses", JCIT, Vol. 6, No. 4, pp. 298 ~ 305, 2011.
[6] Mohammed A. Jabr, Hussein K. Al-Omari, “Design and Implementation of E-Learning Management System using Service Oriented Architecture”, *World Academy of Science, Engineering and Technology 64*, 2010.
[7] G. R. Faulhaber, “Knowledge Consolidation and Inference in the Integrated Neuro-Cognitive Architecture”, in *Journal. 2010 IEEE Intelligent Systems*, pp. 62 - 71.
[8] Mingchao Ma, Volker Schillings, Tongbo Chen, and Christoph Meinel. “T-Cube: A multimedia authoring system for elearning.” In *Proceedings of E-Learn 2003, World Conference on E-Learning in Corporate, Government, Healthcare, & Higher Education*, pages 2289–2296, Phoenix (AZ), USA, November 2003. Association for the Advancement of Computing in Education (AACE).
[9] Andrew Roczniak, Salinah Janmohamed, Christian Roch, Abdulmotaleb El Saddik and Pierre L´evy, "SOA-based Collaborative Multimedia Authoring", MCETECH 2006, May 17-19, 2006, Montreal, Quebec, Canada.

[10] M. Y. Sung and D. H. Lee. "A collaborative multimedia authoring system". *LNCS*, 3033:311–318, 2004.
[11] Pinheiro, M-K, Telecken, T., Zeve, C., Valdeni de Lima, J., & Edelweiss, N. "A cooperative environment for e-learning authoring". Document Numérique, 5(3-4), 89-114, 2001.
[12] I.-C. Chang, "A SMIL-based real-time interactive sharing system for distance learning", *Proc. Tenth Int. World Wide Web Conf. (WWW10)*, May 1-5, 2001.
[13] Sheng-Tun Li, Chu-Hung Lin, Huang-Chih Hsieh, "SCORM-compliant SMIL-enabled Multimedia Streaming E-Learning System in Java EJB Environment", *Twelfth Int. World Wide Web Conf. (WWW2003)*, 20-24 May 2003, Budapest, Hungary.
[14] Á. Segura, A. Moreno, P. Müsebeck and S. Hambach, "Integrating 3D Virtual Reality Simulations in Reusable e-learning Courses" *Proceedings of the 2nd International eLBa Science Conference*, pp. 81-91 Rostock, Germany, 2009.
[15] A. Ortiz, D. Oyarzun, M. Carretero, "ELEIN: E-learning with 3D interactive emotional agents" *Learning by Playing*, *Proceedings of Edutainment 2009*, pp. 294-305 Banff, Canada, 2009

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