AMELIE: Authoring Multimedia-Enhanced Learning Interactive Environment for medical contents

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Abstract. This paper presents the AMELIE Authoring Tool for medical e-learning applications. The tool allows for the creation of enhanced-video based didactic contents, and can be adjusted to any number of platforms and applications. Validation provides preliminary good results on its acceptance and usefulness.

Keywords. Medical education, e-learning, AMELIE, authoring tool

Introduction

Clinical learning paradigms are gradually changing towards structured and objective programs where training is handled according to the nature of the skills being trained (cognitive, technical, judgment), as well the experience of the trainees (students, residents, lifelong learning experts, etc.). Two of the main motivators behind this approach lie in the need for guaranteeing patient safety during and after completion of the formative period and the development of structured programs adapted to the overloaded schedules of both trainees and mentors [1][2].

Technology-enhanced learning (TEL) poses an interesting opportunity for the acquisition of medical and nursing skills in stress-free, ubiquitous environments. Due to its nature, they may provide the necessary learning conditions to train cognitive medical skills anytime and anywhere, as well as to individualize the learner's experience and formative paths [1]. One of the most relevant aspects of e-learning technologies consists on the creation of appealing and appropriate multimedia didactic contents [3]. Multimedia resources, especially in the form of procedural videos are often available at hospitals and clinical centers. While they may be used for classroom tuition, more often than not they are not fully exploited. Moreover, the creation of these contents can be tedious, counterintuitive and difficult.

In this paper, we present AMELIE (Authoring Multimedia-Enhanced Learning Interactive Environment), an authoring tool for the creation of multimedia didactic contents in medical areas such as, surgical and nursing fields of learning. The tool contemplates the definition of complete, personalized didactic units focused on the

exploitation of augmented video resources, with an emphasis on reusability and sharing of contents.

1. Description of the authoring tool

The main core of AMELIE lies in the efficient exploitation of raw multimedia resources available at hospitals (e.g.: surgical interventions, 4D image studies, etc.). The didactic contents are structured in an indeterminate number of sections (to be determined by the author), where text, image and enhanced videos may be included.

For every section the content creator wishes to include, he/she may add a new tab to the didactic content. Within each of these, space is provided to include a main text description, along with images and any additional relevant files. Two main content tabs can be added: (1) regular and (2) video-based. The latter allows the inclusion of an augmented video resource, and provides direct access to an editor where the author may process the raw video (Fig. 1).

The editor offers intuitive methods to modify a video resource by: (1) adding text, audio, image overlays at different points of the recording; (2) crop the video; (3) modify its visual properties (contrast, brightness, etc.); (4) create clips; (5) document the videos; (6) include assessment breakpoints, where the student must answer questions before proceeding or being redirected to other videos and (7) track objects on the screen (by means of segmentation and tracking algorithms specifically designed to that end).

Finally, the possibility of creating an assessment tab is provided. Available functionalities allow for the definition, edition and deletion of the evaluation questions (multiple choice/sorting test-type questions). Additionally, the creator may choose where to place said questions, whether it be within a specific section or on a whole new one at the end of the didactic content.

Contents may be uploaded and downloaded directly to the e-learning platform of choice from and to the authoring tool. Storage is provided in a multimedia content management system (CMS). Multi-language documentation is handled via metadata fields generated in a relational data model through a predefined clinical thesaurus. Once the contents are properly processed, they are published into the platform.
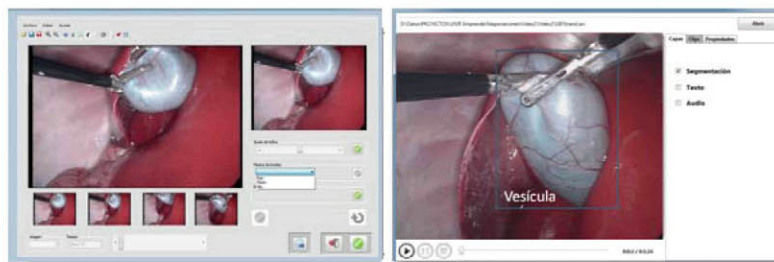

Figure 1. Left: AMELIE video editor. Right: Didactic content intelligent player

A special video player is provided to account for the augmented features of the video resources (Figure 1). The player allows playback/visualization of the different text/audio/image/segmentation overlays, as well as the possibility of toggling them on/off according to the users' preferences.

The current version of the AMELIE tool and video player are implemented in C++ and C# respectively, using Microsoft's (Redmon, WA) .Net Framework. OpenCV library was used to handle all video-based objects, as well as for the implementation of video-processing algorithms.

2. User validation

A practical implementation of the AMELIE tool was performed in the context of an e-learning platform for minimally invasive surgery skills' acquisition. Five surgeons (4 experts with teaching experience and 1 novice) performed a validation experiment in two phases. The alpha test was performed by the surgeons under supervision of the developer. In the beta test, supervision was avoided, and surgeons were allowed to freely use the authoring tool for 30-60 minutes. A likert-type questionnaire was filled to obtain information regarding operational, functional and usability data.

Global results for the validation of authoring tool are shown in Figure 2. Functionality of the tool, video edition tasks, ease of use and learning and usability have been analyzed, in many cases showing good preliminary results.
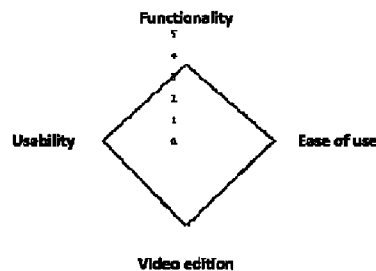

Figure 2. Global results validation. (1: Low performance; 5: High performance)

3. Conclusions

The AMELIE tool is a valuable asset for the creation of medical learning contents in e-learning applications. It provides the mean to exploit the huge video repositories available in hospitals. The tool is intuitive, easy to use and robust, and is accessible to any medical professional regardless of their experience with computers.

References

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