Interactive Video-Training for Medical Professionals

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Abstract: This paper describes an innovative component of an e-learning platform targeted at second language training of medical professionals. This component provides interactive video learning material in three European languages: English, German and Spanish. The implemented prototype integrates storytelling technology with NLP and dynamic web engineering. Starting by the automatic annotation of relevant vocabulary and concepts in the domain of healthcare, our e-learning component associates the videos with external open domain resources, such as thesauri and specialized dictionaries thereby providing a comprehensive infrastructure supplying medical professionals with a situated learning environment as well as with open domain look-up and information retrieval facilities in three languages.

1 INTRODUCTION

Over the last few years, Europe has witnessed an increased mobility of its citizens and professionals. After the removal of the barriers for services such as education and healthcare in particular, more people move abroad to study, reside and work or for medical treatment. In order to facilitate this mobility, the European Union is promoting research for the development of e-learning resources and platforms for second language learning of all European languages.

A good command of the second language, in fact, is particularly relevant in disciplines such as healthcare (cf. (Leroy et al., 2010)), where a missunderstanding between patients and doctors may yield unsafe services, e.g. wrong diagnoses. Recently, much research has addressed the problem of providing high quality multilingual services in the medical domain. Most of this work addressed three main issues:

(i) Providing a unified database/ontology of healthcare terminology that can be instantiated in different languages. MeSH[1], the Medical Subject Headings maintained by the U.S. National Library of Medicine and its counterparts in other languages (e.g. German and French) are prominent examples of such a line of research (see (Nelson, 2009), (Névéol et al., 2007)).

(ii) Providing ad-hoc tools for the multilingual retrieval of scientific literature and medical databases. Most of this work addresses the problem of creating centralized catalogues and semantic indexing facilities that can facilitate the search of multilingual scientific material for reference or study (see (Kreuzthaler et al., 2011), (Grosjean et al., 2012)).

(iii) Providing translation tools for healthcare professionals. MedSLT (Bouillon et al., 2008) is an example of a multilingual spoken language translation system specialized on the medical domain. It was developed with the aim of aiding the communication between patients and doctors in real situations. It supports speech recognition and translation facilities but its coverage is restricted to a few domains (headache, chest and abdominal pain).

However, few e-learning resources exist which integrate all these research trends into a unique platform. In this paper, we describe a component of an e-learning platform specifically developed for teaching second language to medical professionals providing a comprehensive resource that supports individual learning and can be used as well as an assistive equipment in the every-day patient-doctor communication. The e-learning component presented here implements interactive video training material.

A first prototype has been realized based on storytelling technology. In the design of this component

[1] http://www.nlm.nih.gov/mesh/

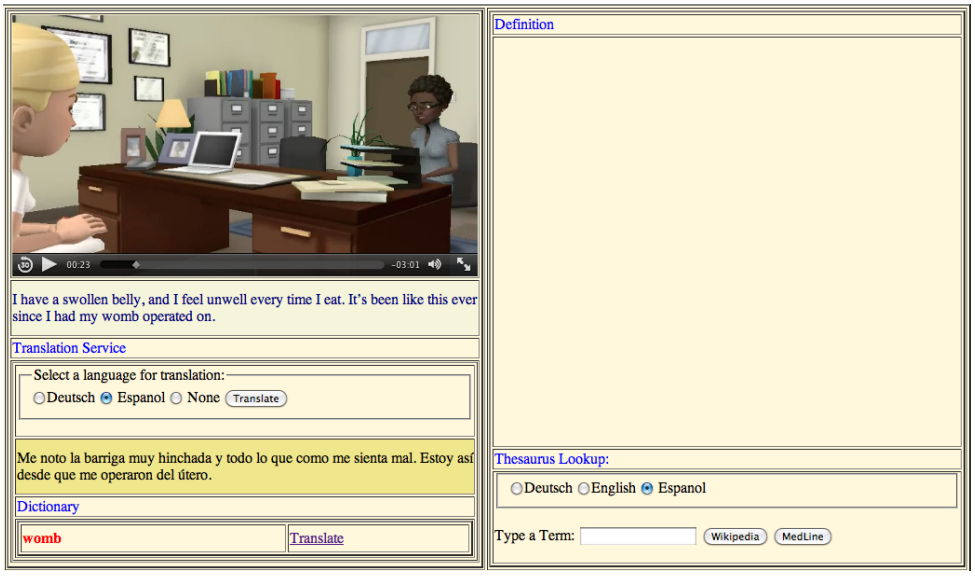

Figure 1: Interactive Video Training: the GUI.

we exploit multi-media and dynamic web technology. In particular, we provide links between videos, produced with storytelling and text-to-speech technology on the basis of real transcript of patient-doctors dialogues, with external resources allowing the user to interact with the content of the video and to access external knowledge.

This paper is organized as follows. In Section 2, we present the teaching methodology behind the design of the interactive video training learning component. Then we introduce the technical framework on which the implementation of the e-learning component is based. We describe the storytelling technology used to realize the video material as well as the system-user interaction model supported by the component. Finally, we show how the videos are linked with external knowledge resources. In Section 3 we conclude with some final remarks and pointers for future work.

2 INTERACTIVE VIDEO TREANING

In this section, we present the framework behind the interactive video training component implemented in our e-learning platform. We describe how video training is implemented and which features support the system-user interaction. Further, we give an overview of the external resources which are linked to the video material.

2.1 THE TEACHING MODEL

Situated learning (cf. (Lave and Wenger, 1990), (Brown et al., 1989)) is acknowledged among the best methodologies for enhancing effective second language learning, particularly in the case of adult learners. A distinctive feature of situated learning is that it presupposes that learning is linked to a real, everyday situation in the target culture and that the learner is immersed in a context where he/she can learn the language in use in that particular situation.

Further, there are several studies that highlight the role of multimedia input in enhancing learner performance and engagement. (Amoia et al., 2011)), for instance, show that children learn new vocabulary in a second language faster, i.e. more effectively and remember more words if they are exposed to both audio and textual/visual input. Video training material can engage learners more than simple text material (Zhang et al., 2006) and it represents an efficient means to implement situated learning. It further allows to fulfill several tasks required by the learning component presented in this paper, and namely:

(i) to improve listening comprehension skills of medics and healthcare givers,

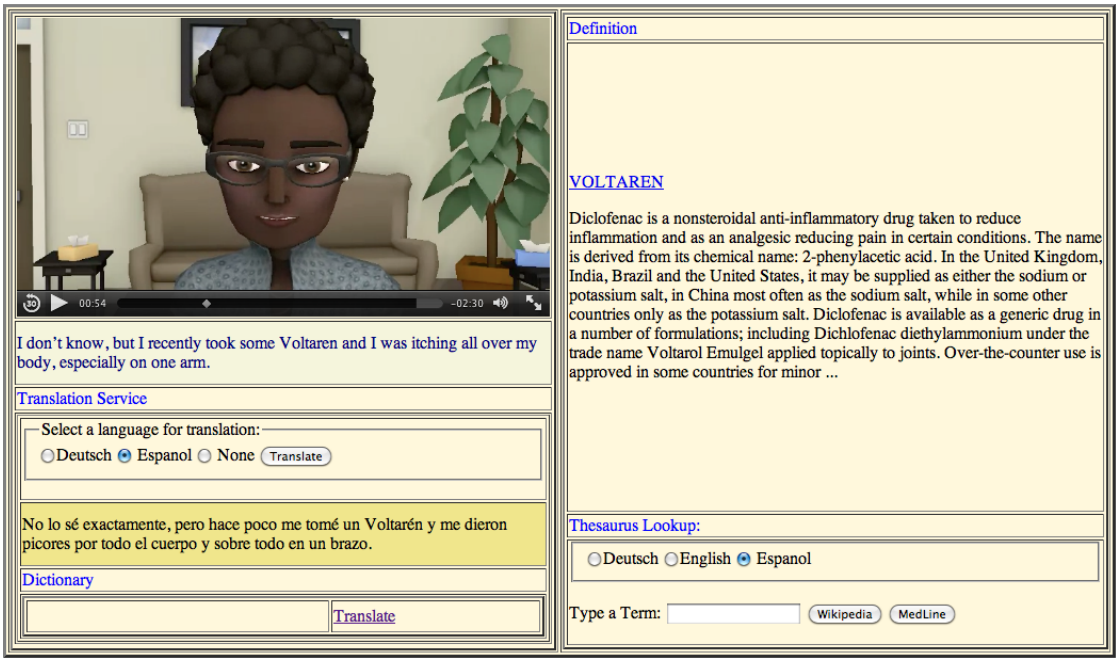

Figure 2: Automatic Links to External Resources.

(ii) to enhance cross-cultural understanding, an essential feature to assure satisfying doctor-patient interaction and safe medical services.

As we focus on language learning in communication, our learning material mainly addresses spoken interaction between patients and doctors. The e-learning component provides interactive video material in three European language, e.g. English, German and Spanish. The target learners accounted for in our framework include the following groups: (i) medical professionals (doctors and nurses) working in a country other than their own, (ii) patients enjoying medical treatments in a country other than their own, (iii) medical professionals working in their own country but with patients speaking a foreign language.

The learning material aims at allowing self-study but also at being used as an assistive resource for reference during real patient-doctor interaction in the clinic or in the daily care work. In order to satisfy the needs of all three groups of learners in the learning component, we distinguish between the *clinical* language used by doctors to communicate with expert colleagues and the more *common, every-day* medical language used to communicate with the patients that are generally laypersons.

Doctors should be able to express themselves in the second language in such a way that the patient can understand them. Thus in the interactive video learning component, we have tried to find a balance in terminological complexity. The dialogues displayed in the videos include a language complexity that corresponds to layperson, every day medical language knowledge and specialized terminology is reduced to a minimum. So for instance in the examples below, we prefer the formulation in (1) to that in (2).

(1) *Do you have any shortness of breath, or breathlessness?*

(2) *Do you have dyspnea?*

Consequently the material can be used for learning by both medical experts and laypersons. Of course, doctors will use the term *dyspnea* in the report for the hospital and talking with expert colleagues. This more specific terminology can be accessed in our platform through the knowledge resources linked to the videos.

2.2 VIDEO MATERIAL AND DIALOGUES

The video material included in our e-learning component aims at recreating real situations in the healthcare

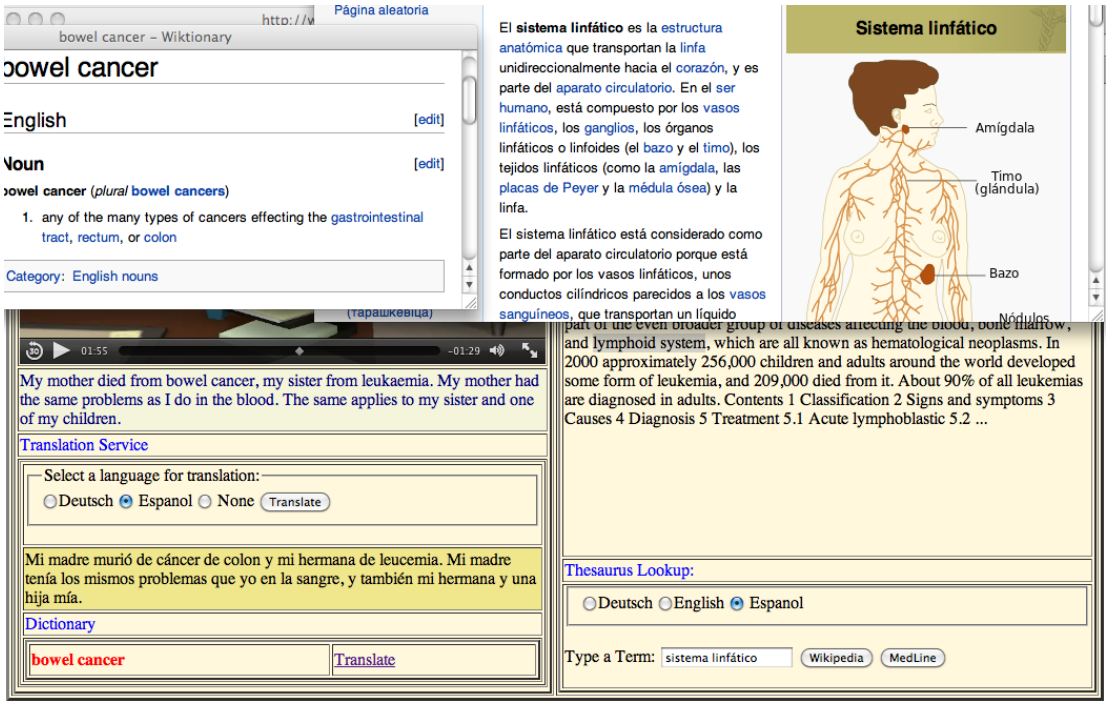

Figure 3: Thesaurus and Dictionary Look-up

domain and typical patient-doctor interactions.

The videos are based on a corpus of texts including typical patient/doctor dialogues gathered by expert physicians in Spain. The topics addressed in these dialogues includes:

- putting the patient at ease,
- collecting patient demographics,
- taking a patient's medical history,
- describing symptoms,
- explaining a treatment to the patient,
- describing the effect of a prescribed medication, etc.

These dialogues have then been translated by expert translators into English and German and reviewed by doctors for checking property of language and naturalness. The implementation of interactive video material based on these dialogues includes two steps:

- creation of the video material,
- making the video interactive.

We start by describing the first step. We use storytelling technology as provided by the Xtranormal[2] platform. This software is partially freely available. This system supports text-to-speech facilities and provides animated video generation from written texts, where animated characters act the patient-doctor interaction. Xtranormal allows to set the value to different features. The system

- supports 20 different languages including those relevant for our e-learning component, i.e. English, German, Spanish,
- provides different male, female and children voices,
- allows to chose between different scenarios (e.g. office, school, hospital) for the animated dialogue and different background sound effects,
- allows to set the camera angle and provides zooming facilities,
- supports different animated characters (avatars) that can walk, sit and even make up to 80 different gestures.

The videos included in the prototype of the e-learning component contain short dialogues (about 5 min) illustrating a typical situation in the medical practice in three European languages. In the next section, we

[2]http://www.xtranormal.com/

describe the second step, i.e. how interactivity is managed in our component.

2.3 SYSTEM-USER INTERACTION

In order to create interactive videos, we exploit the dynamic web technologies integrated into Mozillas HTML5 media framework and Javascript. This framework allows us to manage video, audio and text material dynamically and to link our component to open data resources and web services such as Wikipedia, Google Map, etc.

In order to create an immersive and interactive video experience, we proceed in the following way. Starting from the transcript of a real patient-doctor dialogue provided by medical professionals, we produce the video, and then we automatically generate links to external resources. The written dialogues are parsed and aligned with their translations, and keywords relevant to the medical domain are extracted. Thus, those keywords are highlighted in the textual output of the component and automatically linked to external resources such as Wikipedia and MedLine in all three languages. The timeline managing the interaction with the video is synchronized with the dialogue content. This allows us to extend the video content with hypermedia experiences and links to external resources.

Thus the system supports the following system/user interactions. The user can:

- stop/start videos on demand,
- ask for annotation/transcript of the dialogue being played in the given video,
- ask for translation of the dialogue being played in the video,
- click on highlighted words in the text transcript of the dialogue and thus access external vocabulary information, translation or linguistic knowledge relevant for these words,
- ask for further information relevant to the text topic, such as information from a thesaurus or an external dictionary,

In this way, the interactive video training component of our e-learning system provides a situated learning experience and further allows the learner to freely navigate through the linked open domain resources providing external, probably more specialized content.

2.4 EXTERNAL RESOURCES

The external resources linked to the video in the prototype platform are the following:

Wiktionary At the moment the dictionary lookup is implemented as a Wiktionary query. This choice is motivated by the fact that this resource is freely available and provides dictionaries in the three languages required by our learning component. Wiktionary also supports common medical vocabulary that is relevant to a standard patient-doctor interaction. In order to support physicians at writing specialized reports, we plan to include lookup facilities in specialized terminology resources in our component, such as MeSH.

MedLine, Wikipedia At the moment, the dialogues are linked with the MedLine[3] database that includes a medical domain thesaurus targeting patients or laypersons, and additionally links to relevant articles, books in both English and Spanish. For German or in the case the keywords are not found in MedLine, our component uses Wikipedia lookup.

Google Translate The system further provides translation facilities. At the moment, this service is implemented as a pop-up facility that opens a link to the Google Translate[4] service and can be used by the user for translating new words into his/her native language or in any language supported by the Google service.

2.5 THE GUI

The user can interact with the video training component through the system GUI shown in Figure 1. In a typical learning session while watching the video, the learner can interact with the system by asking for a translation in one of the supported languages (English, Spanish or German). Further, the user is aided in learning new vocabulary. In Figure 1 for instance, the word *womb* is highlighted, as it is recognized by the system as a relevant keyword in the medical domain. The system provides links to (Wiktionary) dictionary entries (in the bottom left slot) and thesaurus definitions of relevant concepts (e.g. *Voltaren*, right canvas on the top). The user can decide to access this information by clicking on the highlighted word. These links are also available if the video is stopped. By clicking on the `Translate` button, a popup window appears providing a link to the Google Translate utilities that can be used to translate a term or a phrase. The user can additionally decide to look up a new concept (e.g. *sistema linfático*) in a medical thesaurus by

[3] MedLine is a service of the U.S. National Library of Medicine National Institutes of Health. http://www.nlm.nih.gov/medlineplus/

[4] http://translate.google.com/

using the thesaurus lookup slot that is provided by the system in all three languages of the project (see Figure 3).

To summarize, the user can stop the video at any time and interact with the text transcript to gather information on highlighted keywords, for instance their translation, or he/she can extract information on arbitrary medical terms from Wikipedia or other specialized databases. The innovative aspect of the component proposed in this paper is that it provides a comprehensive platform for learning and for accessing open domain resources that are directly linked with the learning component, thereby allowing learners to freely manage the language acquisition process.

3 CONCLUSION

In this paper, we described an interactive video training framework for teaching a second language to medical professionals and healthcare givers. The component presented here integrates self-learning facilities with external open domain resources, e.g. thesauri and specialized dictionaries, and provides a comprehensive infrastructure supplying medical professionals with both a situated learning environment and open domain look-up and information retrieval facilities in three languages. We performed a preliminary evaluation of the system mainly based on qualitative criteria and asked users to judge our system in terms of easiness of GUI navigation, usefulness of linked knowledge and enhancement of active learning and engagement. We received encouraging feedback and plan a broader evaluation of our system in hospitals and universities. In future work, we want to extend the range of linked resources to include more specialized terminologies, e.g. MeSH. Further, we plan to develop a self-assessment component and to associate automatically generated training activities to the existent videos, such as fill-in-the-blank exercises based on the same dialogue used to generate the videos.

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