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Instrumentation of classrooms using synchronous speech transcription

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Abstract. This paper presents the ongoing conception of a set of tools, based on live transcription of speech during lectures. The toolset exploits speech and interactions taking place during courses, keeps track of them and facilitates their reuse both in students' studies and in future iterations of the course delivered by the teacher. Its goal is to help students stay focus on the teacher's explanations and offer them greater possibilities of interactions.

Keywords: Learning Web Environment, Transcription Aided Learning, User Needs Assessment.

1 Project overview

PASTEL is a research project driven by LIUM, LS2N and Orange Labs, aiming to explore the potential of synchronous speech transcription and its applications in teaching situations. Speech transcription allows human actors to access the textual version of a sentence a few seconds after it was pronounced, and browse the whole text as they wish. This tool can help students solving comprehension problems caused by hearing, or allows them to use down time to read again a more complex section. Different researches in the literature have demonstrated the advantages of synchronous speech transcription for online courses. For example, Ho and al. [2] argued that synchronous speech transcription helps non-native English students to better understand lectures that are delivered in English. [4] mentioned that synchronous speech transcription can help students with cognitive or physical disabilities, online students if the quality of audio communication is not good, or non-native speakers. To our knowledge, usage of synchronous transcriptions is very limited in pedagogical situations. As part of the project, we will additionally test tools based on other technologies, such as real-time material recommendation and thematic segmentation.

In this project, we intent to explore how the product of real-time speech transcription can help learners and teachers. We also plan to research which user needs can be satisfied, particularly in terms of information. These needs could be satisfied by content derived from the transcription, or by using this transcription as a support of com-

munication. Finally, this project will be the opportunity to study how to index and browsing a great quantity of data growing and formatted in real-time.

2 Environment presentation

We chose to develop our toolset as a Moodle plugin so that it can be integrated to any existing Moodle course platform, along with existent material. Moodle is an open-source learning management system on which teachers can create online course and enroll their students [3]. Students enrolled in a class can access our tool as they would access other activities or resources, and teachers can create a virtual classroom in the same way they would add a page to their course. Functionalities described in the following sections have been implemented in answer to a prior analysis of the practices and needs of students and teachers described in [1].

Interface for students. The material shown during lecture can vary depending on time, and the student may want to finish reading a slide before the teacher moves on to the next one. The environment displays the slide currently projected in class, and users have access to the previous and the next slide of the slideshow, with preview of both of them to facilitate recall. On the left part of the screen, students can watch the teacher's video stream in real-time. Under the video feed, they can enter their questions or their needs in a text field and submit it by pressing enter (the default label states "Enter your questions or express your needs"). The text is then sent to the teacher, and also analyzed by the resource recommendation system.

This system offers a set of links on the right part of the screen, evolving in real time, redirecting to external resources. Each of these resources has a title and a preview limited to a single line of text extracted from the beginning of the document. The first five links suggested are relevant to the topic currently discussed, and changed throughout the lecture. Another five are suggested specially to answer the demand for more information expressed by the students. Each of these resources can be evaluated in regard of its usefulness by the students as soon as they discover it, by either clicking on a "useful" or "irrelevant" button.

The transcription display area is located in the center of the screen and is updated synchronously. It is divided in several paragraphs, each of them being associated to the slide projected at the moment they were transcribed. Each time the professor projects a new slide, a new paragraph is created and the transcription of the current speech is added to it. Each of these paragraphs can be selected, which causes the note-taking panel to open. Besides writing down their notes, students can notify a need for further information to the teacher. The material recommendation system also takes in consideration this alert, and analyzes the concepts being explained or cited in the paragraph to provide relevant information.

To prevent the students from hiding every tool whenever they need to zoom on the slide displayed, a system of panels was implemented. Using this system, students are able to select the tools they wish to keep on screen. The slideshow is displayed as big

as possible depending on the remaining space. Ultimately it can be displayed at full size if every tool is hidden, in order to guarantee readability. Students can hide and show every tool panel at any moment according to their needs. To support the use case of students reading the transcription comfortably for extended periods of time, it is possible to expand the transcription area.

Interface for teachers. A portion of the screen gives visual feedback of the camera, displaying the same video stream as the students receive. The teacher can accordingly place themselves in the camera's field of view. In addition to this page designed for the teacher, a second page displays the slides destined to be projected to the audience. The teacher can navigate the slideshow using the mouse or the left and right arrow keys.

The right part of the screen is dedicated to a text feed showing open-ended questions asked by the audience in real time. The most recent question is stacked on top of the list, and displayed anonymously (even though the sender can be identified by searching the Moodle plugin database, to prevent eventual counter-productive behavior) as soon as it is typed and sent.

At the bottom of the screen is presented a set of indicators, two of them shown as bar graphs. The first one displays the proportion of alerts sent by students estimating the lecture's pace is too quick. If this bar grows too large, the professor can slow down their explanation, to ensure most of the audience can keep up. The second bar displays the proportion of students looking at material corresponding to a past moment. If this bar fills up, the professor may have lost his audience at a previous point, and can react by adapting their speech accordingly. The last indicator is a table detailing the three slides on which the greater number of student expressed a difficulty. If the teacher wishes to know precisely where the problem lay, they could ask student to type it, or look at which slide they asked for more explanation.

The resources recommended to students are displayed in real time, in a table. The display is more concise as the professor does not need to rate, or get a preview of the resources they selected. Only the titles appear, allowing them to recommend a one particular resource to students, or to showcase it on the projected view.

3 Experiment

The prototype was tested with students and a professor in actual class context in order to evaluate usability, to list the benefits of using the system, to be able to analyze usage, and consequently to improve tools supporting the least satisfying tasks. One of the main objectives was to check that the amount of information provided to testers is not a source of cognitive overload. Providing text in real time during a learning activity can trigger such overload, but conversely saving lecture content for later use can relieve students' memory, as it was studied with podcasts [5].

Since the recommendation system is in development, material was selected and tagged by the team designing the system, and associated to a particular slide. However, the system did analyze questions asked by students during the session and auto-

matically considered their demand for more information through the interface. Resources fetched were collected from the web in real time.

The prototype was tested on March 22nd 2018, at Laval during an information and communication lecture. Beforehand, the teacher and students received a presentation of the toolset in order to facilitate later use. During the experiment, 13 students were located in the same room as the teacher and 16 others were located in a remote classroom. During the one-hour lecture, students were given access to the platform and their activity was monitored. Afterwards, the teacher and students were interviewed.

Students were satisfied with the quality of the translation. They reported a frustration in regards of real-time communications as their open-ended questions were not correctly transmitted to the teacher, and the teacher's pedagogical scenario did not include time dedicated to review the audience's questions. Students were confused by the number of tools available simultaneously. They are themselves aware that a comprehensive interface could be useful to users familiar with the system. Yet, as users still discovering the toolset, they are not comfortable enough to both concentrate on the lecture and use every functionality offered. They still expressed the need for more flexibility, particularly the possibility of changing the position of tools on screen. Different students had different opinions concerning which element should be displayed at a large size at the core of the interface. The teacher was not accustomed to monitoring the indicators on his computer screen in real time, and quickly abandoned this behavior to adopt a more usual behavior. His evaluation of the students' activity was hence limited to the audience physically present in the classroom.

Given the high number of class configurations and personal preferences towards practices, we plan to further develop the environment by adding new tools, and a more flexible interface. Other situations than synchronous lecture are also considered.

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