Attendance to Massive Open On-line Courses: Towards a Solution to Track on-line Recorded Lectures Viewing

Enrique Canessa, Livio Tenze, Enrica Salvatori

***Abstract*—Massive open on-line courses (MOOC) such as those by edX.org are digital courses where thousands students are dispersed across the Internet. This new variant for distance learning opens many new challenges including the need to verify the real vision of recorded lectures same as we control the physical presence of scholars in a traditional classroom. We review here a precursor study on the effectiveness of the new Pinvox system (*i.e., "Personal Identification Number by Voice"*), that aims to ensure *"on-line attendance"* by confirming that a particular student has actually listened to and watched a complete video lecture. The preliminary findings obtained during a trial period by students watching videos from home and enrolled at University of Pisa in Italy, indicate that the use of Pinvox can be one step towards, not only ensuring the integrity of on-line certification, but also to sustain student attention and memory retention. Pinvox is based on the injection of unique, randomly selected and pre-recorded integer numbers within the audio trace of a video stream that ideally would need to be identified by MOOC students.**

Keywords —Massive open couses, Education technologies and innovation, on-line learning..

1. INTRODUCTION

Remote attendance to massive open on-line courses (MOOC), such as those being organized by edX.org [1] are becoming popular, largely publicized by the media, and are becoming an interesting new field of learning research. These are on-line courses where thousands of students, and course materials, are all dispersed across the Internet. The first course by MITx: Circuits & Electronics, enrolled about 120 thousand students on-line of which about ten thousand students completed the mid-term exam [2]. These initial MOOC experiences may indicate that the open technologies used are still immature and the lack of more direct human interaction between the many learners and the Lecturer(s) might well affect the quality of this learning experience. MOOC relies on both, watching guided video content and interactive experiences which raise some new questions: i) how to figure out and how to assess the progress of a student at a distance, and ii) how to ensure that scholars completed the video lectures. Nevertheless these issues, the MOOC as a new variant for distance learning opens interesting and unexplored possibilities to offer equal educational opportunities for all for the first time. It makes e-learning really scalable.

Pinvox is our suggestion to certify *"on-line attendance"* as we certify attendance to a live event. It stands for *"Personal Identification Number by Voice" (vox* in Latin*)* and is a prototype system that aims to guarantee that scholars have followed*, i.e.,* listened to and watched, a complete recorded lecture with the option of earning a certificate or diploma of completion after attending courses virtually [3]. Pinvox is based on the (scalable and automated) injection of unique, randomly selected and pre-recorded integer numbers which need to be successfully identified by students from the video or audio files.

By *"attendance"* we do not mean here to understand or even to learn. Pinvox is just about providing a way to be able to tell whether someone has watched a video completely or listened to a whole audio file, such as a Podcast. In a closed environment it is easier to tell the difference between attending an event (*I.e.,* physical presence) and making the best of it (*I.e.,* student assessment). That is why signed certificates of attendance are given to everyone in the classroom and grades are only given to those that successfully complete (written or oral) examinations based on what was discussed inside that very same room. The idea behind Pinvox is to initiate this attendance certificate, for scholars that are at a distance and studying at their own pace (in particular, via m-Learning).

The possibility of awarding *"certificates of virtual attendance"* for academic activities beyond the physical classroom is being considered by renowned scientific institutions such as MIT and Harvard [1]. The idea is to motivate more scholars to watch educational videos and the scientific and educational material recorded during conferences, workshops and seminars. To achieve this goal it is necessary to implement a system that allows us to verify (then certify) the real viewing by students of the recorded material. This is an open field of experimentation.

Motivated by the need to ensure on-line attendance, this is our first study and implementation of the Pinvox method. We asked students to test, during their Summer holidays (prior to the Autumn examination in person), the Pinvox methodology as applied to the humanities course on "Cultura Digitale"

organized by the MA course degree in "Informatica Umanistica" (Digital Humanities) of the University of Pisa in Italy. Interestingly, we have found that the use of Pinvox can not only be one possible step towards ensuring the integrity of on-line certification, but it can also help to induce further attention and memory retention by the students.

Assessments mechanisms for students following on-line courses have been extensively discussed in the literature, whereas verified video viewing for on-line certification via MOOC has received little or no attention. This is the first study of this kind to our best knowledge.

2. The Pinvox Method

Pinvox is just about providing a way to be able to tell whether someone watched a video completely or listened a whole audio file. It stands for *"Personal Identification Number by Voice" (*from *Vox in Latin)* [3]. It is based on the (automated and scalable) injection of unique, randomly selected and pre-recorded integer numbers (or audio PINs) within the audio trace of a video stream, which need to be identified by the viewers. These numeric audio signals superimposed on the original video/audio stream in different formats cannot be easily spotted by students even by fast forwarded an rewound of the recordings or analyzing their audio signal plots.

Pinvox is easy to install and easy to use. It runs in any computer with MS Windows O.S. Or the free Ubuntu Linux O.S. And it can be downloaded from the website: www.pinvox.org In brief, the unique audio PIN codes within Pinvox are:

- composed of few pre-recorded numbers;
- generated on-the-fly for each video/audio input;
- superimposed into the audio trace of the speaker(s) at places where (in principle, but not necessarily) silence is detected by the algorithm after some default noise tolerance;
- only identified in most cases when watching the whole video only.

The Pinvox Graphics User Interface (GUI) is display in Fig. 1. It allows to select:

- the input audio or video file. The final video, audio plots and audio PINs (i.e., Pinvox general outputs) are created in the same directory than the original input file;
- the period of silence (in which the Audio PINs are injected by the algorithm);
- the number of copies to be processed that will contain the "Personal Identification Number(s) by Voice".

The Pinvox algortithm starts processing the input (audio or video) file by

- identifying first the format of the input file;
- extracting the audio trace of the input video file and making a copy of the video without audio (if the input file is audio then it does nothing);
- searching for time positions within the audio trace of all available period of silences according to the selected value. After this search, then
- the GUI algorithm selects randomly (up to 14) Audio PINs and finally,
- it re-injects back into the video with no audio the new audio trace with audio PINs.

All of these automated processes can take time to complete. The Processing status is indicated in the GUI by a red bar for each of the videos with Pinvox to be executed. The longer the video/audio input, the longer the algorithm takes to embed the audio PINs. The most time consuming processes are the extraction of the original audio trace from the video input, and the re-injection into the same video of the new audio file with the embedded audio PINs. The process of finding the selected period of silence and of choosing randomly pre-recorded numbers is by far faster. After all these processes complete successfully, then the file containing the audio PIN codes and the Pinvox audio data plot(s) (useful for preview and comparison against the original audio inputs) become available for distribution to the students.

3. Certified Vision with Pinvox

New opportunities for learning exist world-wide with the use of technology in education and the availability of broadband Internet at accessibile costs. Scholars can today study at their own pace via free rich-media material see *e.g.* MIT's OCW, ICTP.tv, Khan Academy, University of the People [4], which can be watched or listened when, where and as often as chosen. Some necessary conditions for learning, even at a distance, are *I)* the *retention* of information, which can be improved by note taking while paying attention to a video or a classroom lecture, *ii)* the *focused attention* or *concentration* to encode knowledge in our memory and *iii)* the ability to

Figure 1 - Simple Pinvox GUI for video or audio input, processing and ouput.

consciously recollect previous experiences from memory (*i.e. Episodic memories*). The encoding theory of Tulving (1972) points out the importance of the "retrieval cues" in accessing the episodic memories needed in learning.

As in the case of education inside traditional classrooms or lecture halls, the aforementioned necessary conditions for learning remain unchanged for scholars attending classes virtually since they relate to the human nature, the psychology of learning and not much to the technology used. The technology, including the Pinvox tool, can just facilitate and improve the educational process [5].

We carried out the first '*in-situ'* implementation of Pinvox by asking two postgraduate students (*'in appello')* to test, during their 2012 Summer holidays (prior to the Autumn examination in person), the Pinvox algorithm as applied to the humanities course on "Cultura Digitale" organized by the MA course degree in "Informatica Umanistica" (Digital Humanities) of the University of Pisa in Italy. The course consisted of following 16 videos with an average length of 90 min each, recorded by different Lecturers in different topics ranging, *e.g.,* from the creation of eBooks to Cultural Heritage and Pervasive Information. Each student had to watch these educational videos at their own pace and identify the random audio PINs embedded in each of these by the Pinvox method. In total there were 142 audio PINs to be identified by student one and 165 by the second student, making an average of 10 audio PINs injected per video. Both students identified all these pre-recorded numbers with an error of only 2%, which could be due to some distraction or due to the lack of familiarity with the Pinvox method, since these errors of identification only appeared within the 3 first videos.

We then asked the students to complete a questionnaire to compare their attitudes towards Pinvox as a tool to ensure their on-line attendance as well as attention to the contents of the 16 video lectures. Analysis of the results of this study indicate that students believe that Pinvox helped them increase their attention to the lectures, not only on the subjects of their main particular interest, but specially in the topics that were of less interest to them. They also indicated that there is no difference in identifying the embedded numbers *per se,* or together with the timing in which these appear within the video. A higher attention level remains unchanged, since the ringtone that anticipates the injected recording numbers helps them to keep note on the timing and the PIN without losing concentration on the lecture.

In general, these findings suggest that the adoption of Pinvox, as a new and unique learning experience, could well became useful for other courses that use multimedia materials without having the physical presence of the student in the classroom, and which requires great attention and retention of information.

Information given in the middle is least remembered. Pinvox helps to increase attention.

Appropriate stimulus or "retrieval cues" may avoid retention loss (or forgetting), as opposed to the decay of memories over time or interference from other memories —which are stored in our short term and long term memory system [6]. The audio cues attached by the Pinvox algorithm into the digital contents aim instead to increase *attention* and *retention* throughout a lecture and to reduce the Primacy-Recency effect as shown in Fig. 3 [7,8]. During the learning episode, one not only remembers best what comes first, or what come last, but we also better retain the information which come with the video where attention is called up using Pinvox by means of audio PINs.

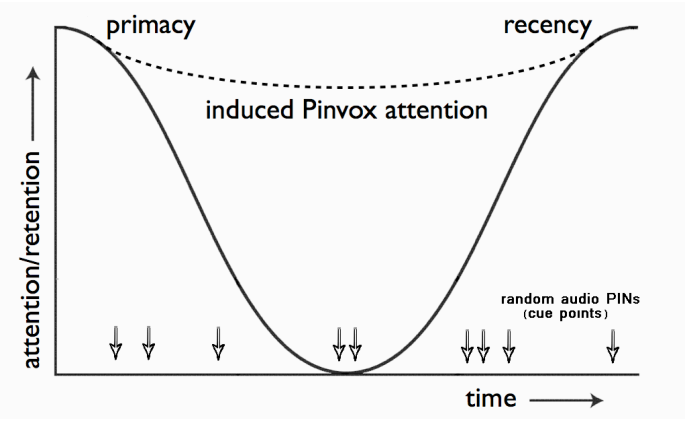

Fig. 3: *Primacy-Recency* effect -the earliest and latest information in a Lecture is best recalled.

Pinvox may therefore allows to:

1) Verifying attendance through the entire video/audio learning experience,
2) Increasing sustained attention across the entire video/audio learning experience,
3) Increasing retention between primacy and recency peaks.

From this study we can inititally deduce that Pinvox helps to ensure attentive viewing of educational video material or audio files which can be fast forwarded and rewound. Thus, conditions and facilitation of learning via guided contents within the CMS Moodle for student assessment and *ad-hoc* tools like Pinvox are the main ingredients for supporting the new era of self-paced education and learning.

On the other hand, Pinvox cannot substitute a Tutor for discussions, stimulus, answers, especially when the learner is in a remote place. But in the specific case of distance learning, Pinvox can guarantee the attention to what is being projected on the video since it offers better certainties on the student participation to the educational process, even if virtual. For courses with a large number of students (*e.g,* such as those organized by edX.org from MIT in which thousands scholars are being registered), the control of PINs delivered by the students would need to be automated. The findings reported in this first study support the view that the adoption of Pinvox can be a feasible step to assure the integrity of awarding on-line certification.

The use of Pinvox seems to offer clear benefits as perceived by our postgraduate students in terms of attention and attendance and how much they feel they learnt. Coupled with the advantages of flexibility in when, where and how videos or Postcasts are used, Pinvox appears to have significant potential as an innovative supporting tool for learning and on-line attendance certification. For the instructor, the most professional benefit is to use a tool that makes sure that his/her audio-video material has been completed by the student —a

great advantage from the pedagogic point of view. Finally, we believe the adoption of Pinvox may also open the door to facilitate learning experiences with people who have disabilities and learning difficulties.

Evaluation mechanisms for students following on-line courses have been extensively discussed within e-learning, distance education and mobile learning programs, whereas verified video viewing for on-line certification via MOOC has received little or no attention. Both types of assessments are necessary to have a reliable mechanism that leads to obtain an academic certification on-line. So far as we know, besides Pinvox, there is no another way to guarantee that thousands of students (as those expected to attend future MOOC) have gone through the whole video lecture view. Even if the number of students participants may seen as not statistically sound, this is the first study of this kind. the results discussed open the path for further investigations on verifying attendance to MOOC.

Pinvox offers an original solution to track online recorded lectures viewing with the increasing emergence of Massive Open Online Courses (MOOCs) in higher education. Attendance assurance is greatly established, because the system is always generating a different Pinvox code for each student and video delivered. Students may pass their codes each other, but these are all randomly different.

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