Pinvox Method to Enhance Self-Study in Blended Learning

Experiences at University of Bucharest

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***Abstract*—We report results on the first large-scale trial implementation of the new Pinvox algorithm carried out at the Department of Distance Learning (DL) of the University of Bucharest to encourage hundreds of Bachelor and Master DL students to perform their self-study. Pinvox is an open source tool that helps to ensure *"on-line attendance"* and to induce *"student's attention"* through the identification of different, randomly selected, brief audio PINs embedded automatically in videos or audio files assigned to each student. We argue that checking how students watched a video lecture has many advantages in the formative assessment work.**

***Index Terms*—Blended learning, MOOC, Pinvox, Distance education**

I. INTRODUCTION

According to the current Romanian legislation there are two types of Distance Learning (DL) study programs in the country: *"Invatamant la Distanta"* (ID) and *"Invatamant cu Frecventa Redusa"* (IFR). These programs are very similar and, in practice, they fit to the concept of *blended learning* [1]. The ID and IFR are flexible forms of education that offer students the opportunity to manage learning at their own pace within a DL program merged in a renowned organizing educational institution, where they also spend classroom time for the application of this knowledge. Taking advantage of this flexible educational process, students can enroll regardless of their age or working hours schedule. In order to obtain proper assessments and offer the best working conditions, these blended learning programs are open to new pedagogical and technological challenges.

The role of the "*Department for Distance Learning*" (DDL) of the University of Bucharest in Romania [2] is to design, implement and manage DL study programs according to the new National Education Law (LEN nr.1/2011) dated *January 10th, 2011*. These DL programs have initial authorization and final accreditation by an independent body: the Romanian Agency for Quality Assurance in Higher Education (ARACIS), which is a full member of ENQA [3] and is registered with EQAR [4]. The most important result of this authorization and accreditation is that the Romanian DL Diplomas are officially recognized to be equivalent to full-time study Diplomas given to students with traditional (daily basis) attendance to a University. These students are trained, and evaluated, using modern tools similarly to those of existing open DL-High Education Institutions around Europe and their final examinations (*i.e.*, summative assessments) are done with presence on-campus.

As a matter of fact, at present, DDL has accreditation for Bachelors BA-ID (Primary and pre-School Teachers, Geography, History with 180 ECTS) and Master MA-IFR (ICT in Education, Management, School Counseling with 120 ECTS). The interaction and exchanges with all these DL students are managed through the DDL's virtual campus, using free Google Apps for education, CISCO WEBex and other information and communication tools (see list of tools in [5]). About 30% of the on-line courses are implemented in the subject areas of the MA-IFR.

During the period of self-study, the proper use of the DDL recorded material needs to be verified to ensure a correct and responsible blended learning process. For this reason, it became necessary to implement an appropriate technological method to provide a way to tell the teacher whether his/her DL student watched the videos completely and/or listened the whole Postcast files assigned. This step is necessary to enhance self-study and certify students' virtual presence as we usually certify attendance to a live classroom event.

In this paper, we present the results of our first large-scale and statistically significant implementation of the new Pinvox algorithm within the blended learning programs of the University of Bucharest. A total of 240 DL students of BA-Bachelor (147) and MA-Master (93) followed such DL courses and participated in our Pinvox tests, and about 60 (*i.e.*, 41%) and 52 (*i.e.*, 56%) of them replied to a Users' Questionnaire, respectively. Pinvox stands for *"Personal Identification Number by Voice"* (Vox in Latin). It is a free, open source tool that aims to verify the *"assignment"* and assure *"on-line attendance"* by the identification of unique, randomly selected audio PINs embedded automatically in educational video or audio files [6]. We present and discuss some facts and figures which show how the Pinvox method is matching satisfactorily the needs of the DL and IFR programs of the University of Bucharest.

II. THE PINVOX METHODOLOGY

Pinvox is based upon the automatic injection of unique, randomly selected and pre-recorded numbers (or letters or single words) within the audio trace of a video stream, which must be noted and later given back by the students to the Lecturer. This method is being developed by the ICTP Science Dissemination Unit in Trieste, Italy and can

be downloaded from www.pinvox.org [6]; it runs on any computer with MS Windows and Linux Ubuntu OS. The allowed audio formats are: wav, mp3, wma; and for video are: avi, flv, mov, m4v, mp4, ogg, ogv.

In short, the simple idea behind Pinvox is:

- to compose automatically a set of audio PIN codes of few pre-recorded random numbers, which are unique for each student and are generated *on-the-fly* for each video/audio input.
- These audio PIN codes are superimposed onto the original audio trace of the speaker(s) at intervals where (in principle, but not necessarily) silence is detected by the algorithm after some given default noise tolerance.

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

- the input audio or video file;
- the period of silence in which the audio PINs can be injected by the algorithm, and
- the number of copies to be produced that will contain the random *"Personal Identification Number(s) by Voice"*.

By selecting *"Silence periods"* the algorithm identifies segments within the video where to inject pre-recorded numbers of audio PINs between 0,1, . . . 9, that are anticipated by a short ring-tone to draw further attention. It is also possible to select *"How many output videos"* are to be processed and re-initiate the GUI process many times (on scale) in order to create many sets (up to 3 at the time) of video or audio files with superimposed audio PIN codes. After the processing in Fig.2, the Pinvox outputs obtained consists of: *i) a* modified video (or audio), *ii)* audio signal plots as in Fig.3 , and *iii)* the list of audio PINs inserted.

As shown in Fig. 2, the GUI starts processing the input file by *I)* identifying the format of the input file, *ii)* 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), and *iii)* searching for time positions within the audio trace of all available periods of silence, according to the chosen ratio. After this search, then *iv)* the GUI algorithm selects randomly (up to 14) audio PINs and finally, *v)* re-injects back into the temporary video without audio, the new audio trace with embedded audio PINs. All of these processes are automated and take some time to complete, depending on the length of the inputs. The processing status within the GUI is indicated in the GUI by a (red) bar for each of the videos.

After all processes are successfully completed, the last GUI window with Pinvox outputs allows to:

- preview the plot(s) with the random Pinvox audio data as in Fig.3 and to compare it against the original audio input. The audio PIN codes are, in most cases, only identified when watching the whole video. The numeric audio signals superimposed onto the original video/audio stream cannot be easily spotted by students plotting the audio signal or zapping through the videos.
- Check the file containing the actual sequence of the Pinvox code. Audio PIN codes are in most cases identified when watching the whole video only.

Figure 1. Pinvox Graphics User Interface (GUI).

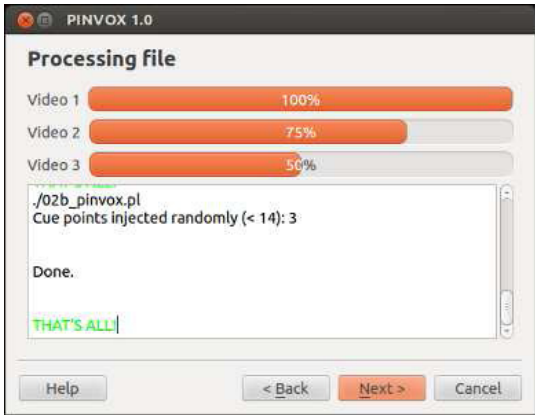

Figure 2. Example of Pinvox processing.

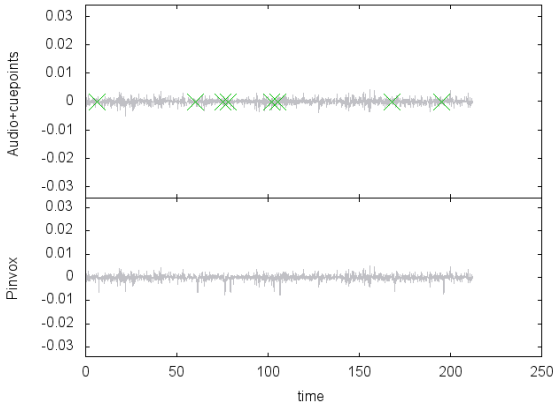

Figure 3. Example of the random Pinvox audio data against the original audio input.

Since all of these processes are automated, the use of the free Pinvox software allows a Lecturer to easily prepare the digital material for his/her DL students.

III. DISCUSSION

Education at DDL is combined with *face-to-face* meetings and assessments, between instructors and learners on some weekends, and integrated with computer-mediated activities and on-line course contents specially tailored for the students, that they can follow at their own pace. There are 500 ID and 300 IFR students enrolled in these programs coming from Bucharest and nearby regions (< 200 Km) and from far away ~600 Km.

The curricula for full-time enrollment in University of Bucharest's programs include: traditional; courses, lectures, seminars and laboratories (with practical activities). In the curricula for ID and IFR programs, *i)* the traditional *face-to-face* lectures are replaced with a self-study based on the learning resources prepared according to the ID methodology (providing students with recorded video-lectures) plus a recommended bibliography; *ii)* the practical activities are renamed *"assisted activities"* and are identical to practical activities in a Lab. All ID and IFR students are obliged to attend on-site meetings for formative evaluation with their peer students and teachers (scheduled every 2-3 weeks, usually on a Saturday or Sunday) and to perform other academic activities during the semester time, like video-conferencing meetings, plus home assignments, on-line tests, etc. The goal is to avoid (as much as it is legally possible) excessive trips to Bucharest and reduce costs by carrying out most activities on-line and at a distance and not inside classrooms.

We have introduced for the first time the Pinvox method on a large-scale and asked 240 Romanian DDL students to watch the educational videos of their courses and to identify the random audio PINs embedded in their assigned recording material. During the present trial, the videos used were 10 to 30 min long and were produced using the automated openEyA recording systems [7] in conjunction with the Pinvox software [6] to obtain three new videos at the time, which were uploaded to Google_Drive. Students were then informed to download one item each and to perform their self-study. A deadline of about two weeks was given to receive their answers and 112 students replied to our volunteer questionnaire. All 147 Bachelor (41%) and 93 Master (56%) students who were involved in this first implementation test identified the complete Pinvox sequences correctly.

After this initial large-scale implementation of Pinvox, we decided to evaluate the potentialities of the method from the point of view of the students by asking them to answer the following questions focusing on their experiences, opinions and suggestions for improvements. The participating students' replies and the questions of the survey carried out using Google Moderator were as follows:

Q1. *Do you believe that the Pinvox method increases your interest for self-study?*

A total of 106 (of the 112) students involved in this Q1 survey participated in the Pinvox trial and 85 of the responses received expressed that Pinvox can be a very useful tool for individual DL verification. It enhances further attention on the video lectures. Although at a first glance, one may think that students may be more attentive to the embedded audio PINs than to the video contents, in fact we found a greater student's involvement with the recordings since Pinvox increased their interest in learning. Indeed, students watched the video lectures more than once to make sure of getting the correct Pinvox code. Some of them did not know *a-priori* how interesting the video may have been, but certainly Pinvox *"forced"* them to be more careful when visioning it. The remaining 21 answers indicated *"I do not know"* or *"Pinvox is not useful"*.

Q2. *Did your focus on the embedded audio code influence your focus on the academic video? (in other words, was your capacity to understand the digital contents disrupted by Pinvox?)"*

A number of 105 students replied to this query and participated in the Pinvox test. Only 5% of students found the Pinvox algorithm a disturbing factor. They concentrated on the video first for the lesson and then listened to it again to focus on the injected audio sequence only. These students could not carry out simultaneously both actions, so it was pretty stressful and time consuming for them. The rest, 95% of answers, agreed that the student's capacity to understand was *"very little"* or *"not at all"* disturbed. The short Pinvox audio PINs sequences did not affect alertness or concentration of students to the digital contents. In the extreme cases, happening only occasionally, in which multiple random audio PINs may span or be concentrated within a short period of time (*e.g.*, 3 random pre-recorded numbers appearing in one minute of video stream), a student may be distracted by a too dense background sound. However, some students reported that attention to the topics discussed is enhanced with the introduction of these sound sequences. A few of them listened to the recorded lessons twice or more to be sure of the sound sequence which, in turn, contributed to a better understanding of the video material. Pinvox signals cannot go unnoticed or missed though. The numeric audio values superimposed on the original video (which can be fast forwarded and rewinded), cannot be easily spotted by students (*c.f.*, Fig.3).

Q3. *Do you believe that it might be useful to ask also for the time when Pinvox sounds appear/happen?*

39% of the 89 students believe that it would not be useful to retrieve the time of the sequences, although it would not be complicated to identify them. In doing so, the emphasis would be too much on the Pinvox method rather than on understanding better the recorded lecture. In this case, students would pay more attention to the pre-recorded, random numbers than to the educational contents. For the other 61% of students, the introduction of this extra requirement would not require great effort and it would be more interesting in order to have a more rigorous verification by the Lecturer.

Q4. *Do you have any suggestions to improve Pinvox?*

A total of 88 students involved in this Q4 survey participated in the Pinvox test, and 56% of them gave us no suggestions. The main suggestion received from 44% of the other students concerns the audio PINs features. These sound sequences were pre-recorded in English and were injected randomly into the videos using the available Pinvox tool. Few times certain figures could not be heard clearly and not understood correctly due to the foreign language barriers. It would be necessary to consider a variant version of Pinvox in Romanian language with a better sound quality for, and familiarity with, the recorded PINs. For example it took a while for a student to figure out if the number given was 8 or 3.

Another suggestion was not to use an audible sequence of numbers but to announce a question or statement relating the topic of the lesson. However, to this end we note that the Pinvox algorithm used is meant to be on scale and fully automated, so that the creation *on-the-fly* of random numbers can be done for thousands and millions of different students. With embedded questions, instead of using random numbers, all of these questions should have to be created *ad-hoc* and coded/checked differently for

every single student. For Massive On-line Open Courses (MOOCs) where thousands of students follow recorded lectures at a distance [8], this exercise of checking for correct anwsers would be extremely time-consuming for the Lecturers, specially for on-line courses of Physics and Mathematics where even a tiny dot can make a difference.

IV. FINAL REMARKS

In traditional classroom teaching, it is customary to verify the students' presence attending a full-time course by asking them to sign a paper or to call their names a *viva voce*. The application of the Pinvox method aims to be equivalent in the case of distance and blended learning and to ensure a responsible vision of recorded lectures during the period of self-study.

The new Pinvox method can provide the control of the off-campus activities aiming at forcing scholars to study throughout the semester period, and not at the last moment and just for their final exams. The student's engagement becomes higher since he/she gets more and more involved with the self-study as the embedded Pinvox sequences capture their attention. These need to be successfully reported to their Tutors; however, this process needs to be automated as much as possible to avoid any extra workload on the Lecturers.

This first large-scale study with Pinvox indicates that there are no additional difficulties in identifying the embedded random audio numbers *per se*. The Pinvox algorithm avoids the use of images superimposed on the video frames because these can be easily spotted by forward and rewind commands on the video.

In view of the statistically significant results presented, we can argue that Pinvox offers students an opportunity to establish their own plan of study, which can be verified by their Instructors, and increase attention towards the recorded lectures. Future plans include to use at least five Pinvox-encoded videos per semester under the ID/IFR programs. Within ID/IFR, it is an obligation for every Professor to perform at least two formative assessments per subject he/she is teaching per semester. The name given in Romania is *"Tema de control (TC)"*. The student can obtain 10-30% from the final mark if he solves correctly these TCs. The key issue is to include the Pinvox method within formative assessment (during the semester) and to provide points (to the correct answers) that will be added to the student's final mark.

Analysis of the results found in the students responses, allowed us to compare their attitudes towards Pinvox, and to conclude that this innovative method appears to have a significant potential. It helps to ensure virtual presence, self-study as well as to increase attention towards educational videos. The Pinvox method seems to be very useful in connection with video-lecture cross-check that is provided to students in parallel with the traditional *face-to-face* lectures.

As we have reported, checking that students watched a video lecture has many advantages in the formative assessment work assigned to the students enrolled in the ID/IFR study programs of the University of Bucharest. These benefits are coupled to those in the flexibility of study and in the increase of student's responsibility.

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