On gamifying the transcription of digital video lectures ☆

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ABSTRACT

Games can be used to exploit the computational power of humans to perform tasks that are difficult for computers. One of these difficult tasks is the transcription of video lectures. Indeed, the characteristics of the speech that occur in video lectures are not well suited for speech recognition technologies. In this paper we propose ALGA, an ALtruistic GAme, designed to involve students in the production of transcripts. Players challenge each other by listening to short, and randomly selected, pieces of the audio stream, and by submitting the corresponding transcription. When two players (unknown to each other) submit the same version, the transcript of the audio chunk is considered correct and the players gain points. To motivate players, ALGA provides the final transcript to all the players and maintains a high-score list for every video lecture. The evaluation shows that the accuracy of the obtained transcripts is higher than the one obtained by speech recognition technologies and also shows that participants like the game approach. Hence, ALGA can be considered a reasonable, feasible and affordable solution to produce transcripts from video lectures.

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1. Introduction

Many private and public educational institutes use video lectures to improve the effectiveness of teaching in and out of classrooms and to support distance-learning students [1–4], but the accessibility to this material is not as easy as one may think. Indeed, millions of people have difficulties in listening to a lesson (e.g., hearing impaired students), in taking notes (e.g. motion impaired students) or in understanding how a teacher speaks (e.g., English as a second language students) [5].

To increase the accessibility of video contents, many educational institutes provide students with the transcripts of the video lectures. These transcripts are produced either by human beings or by software. The former approach produces accurate transcripts but the process is time consuming and expensive; the latter approach employs ASR (Automatic Speech Recognition) software and takes advantage of the advances in speech recognition technologies that allow to achieve accuracy up to 99% when correctly trained, when used for dictating purposes and when using good quality microphones in a good acoustic environment. Unfortunately, in the classroom scenario the accuracy may drop a lot: recent studies show that the accuracy of speech recognition in a classroom scenario is usually less than 70% [6]. In fact, the classroom scenario is very different from the dictating one, as the

spontaneous speech that occurs in a lecture is acoustically, linguistically and structurally different than the one used to create written documents: the speaker talks at different speeds and different volume to emphasize some part of the speech, he/she often uses fillers (e.g. uh, er, um, ah), sometimes he/she hesitates in the middle of a word and does not speak punctuation marks ('comma', 'dot', 'question mark', etc.) [7]. Therefore, in most cases, the transcript produced by a speech recognition application needs to be copy edited. Since professional copy editing might be too expensive, a recent approach involves the use of online task markets, such as Amazon Mechanical Turk, to obtain low-cost and high-accuracy transcripts [8]. However, although less expensive, this solution might be not affordable for many educational institutes [9].

Motivated by the continuous success of social games and applications [10,11], in this paper we study a possible *gamification* of the transcription process and we propose ALGA, an ALtruistic GAme, designed to involve students in the process of transcript production.

The use of games in the educational scenario is not new: traditional board games and role-play games were used for learning long before the arrival of digital games and several studies agree that games, either digital or not, might play an important role in formal education [12]. Indeed, modern theories of effective learning suggest that computer educational games could provide a rich-resource learning environment and the potential benefits of using video games as ideal companions to classroom instruction is unquestionable [13,14]. Furthermore, the use of elements of

game to motivate learning is seen as "a serious approach to accelerate the curve of the learning experience, teach complex subjects, and systems of thought" [15]. For these reasons, computer games are more and more used in various learning scenarios, e.g. classroom education, government, financial services, health-care, science, telecommunications, corporate, military training, etc. [16].

In this paper, the game we propose to involve students in the transcription process falls in the area of Game With A Purpose (GWAP) [17]. GWAP games are used to exploit the computational power of humans to perform tasks that are easy for humans, but difficult for computers. An example of GWAP game is ESP [18], a game designed to label pictures: as known, it is very difficult for computers to understand the semantics of an image, but this task is quite easy for humans. Therefore, ESP gamified this process by displaying the same picture to two players (unknown to each other) and by asking them to label the picture. If players submitted the same label for the picture, the label was considered appropriate.

Our proposal aims at gamifying the transcription process of video lectures with an approach that does not require the use of any speech recognition technologies, of professional copy editing and of monetary incentives to motivate players. All ALGA needs is the audio stream of the video lecture and the students playing.

Briefly speaking, ALGA automatically splits the audio stream of the video lecture into several short audio chunks (length in the range 5–20 s) and randomly presents one of these audio chunks to a player, asking him/her to submit a transcription of it. If the entered text matches a previous submitted text, the player (and the one who submitted the text that matches) gains points. After playing with a chunk, the player can play with another one and he/she can play as many chunks as he/she wants. A high-score list is maintained for each video lecture and when a player is passed in the ranking, he/she is informed (e.g., through e-mail) in order to encourage him/her to play again. The transcript is made available to all the players when the percentage of audio chunks correctly transcribed is above a threshold (defined by the game administrator, usually the video lecture speaker).

In addition to transcription, ALGA allows to play with links to external resources: players can suggest resources that contain materials to deepen the study of the topic(s) covered in the video lecture. Also in this case, if the entered link matches a previous submitted link, the player (and the one who submitted the link that matches) gains points.

The evaluation of the proposed game shows that the game approach is appreciated by students and also shows that the accuracy of the produced transcript is higher than the one obtained through ASR technologies. Therefore, ALGA can be considered a reasonable, feasible and affordable solution to produce transcripts from video lectures.

The remainder of the paper is organized as follows: Section 2 presents related work in the area of transcript correction; Section 3 shows details of the ALGA proposal, whereas Section 4 shows the ALGA evaluation study. Conclusions are drawn in Section 5.

2. Related work

The gamification of the transcription process of digital video lectures involves different fields: the use of games in education, the gamification approach, the transcription of digital lectures and the game with a purpose scenario. In the following, we overview studies in these different fields.

2.1. Serious games in education

In the past years, different studies showed that well-designed computer educational games provide undeniable benefits and might be well suited for active learning as they provide a learning environment able to foster the higher order knowledge and the skills of students [13–16]. Indeed, most computer games are active, experiential and interactive and these features are those that most influence effective learning [13]. Therefore, it is not surprising that games are being employed more and more into learning environments (e.g. classroom education, financial services, healthcare, military training, etc.) [16,19]. For instance, Corti [20] analyzed the use of serious games in the learning environment and found that the benefits of using video games is unquestionable. Hwang et al. [21] showed that games are perceived as a means to engage players in enjoyable activities to accomplish some challenging objectives. Wrzesien and Alcaiz Raya [22] indicated three main reasons for the ever-increasing use of serious games in education: (a) they use actions rather than explanations and create personal motivation and satisfaction, (b) they accommodate multiple learning styles and abilities, and (c) they foster decision-making and problem-solving activities in a virtual setting. Gentile and Gentile [23] observed that the use of computer games in the learning environment brings happiness and sense of achievement to learners, thus helping them to improve their learning results and stimulate them to think; these advantages suggest that computer games could be applied to improve traditional methods of teaching. Ebner and Holzinger [24] found that students who use games in the learning environment produce learning results that surpass other methods of traditional teaching. Finally, we observe that researchers have developed computer games to improve learning for diverse disciplines, such as mathematics, computer science and linguistic (e.g., [25–27], just to name a few).

However, it is worth mentioning that the use of serious games in the educational scenario is also subject to a critical thinking. Guillen et al. [16] highlighted that there is still little consensus on the process by which games engage learners and on the types of learning outcomes that can be achieved through game play. Connelly et al. [13] observed that it is difficult to understand the effects of games. Lin et al. [19] observed the difficulties in developing effective games for the learning environment.

Far from settle the debate, we observe that a recent trend in education is the usage of the so-called "gamification" approach.

2.2. The gamification approach

Since the initial proposal of using computer games in the educational scenario, the use of games for learning purposes has evolved and recently the "gamification" process has gained significant attention [28]. This process refers to "the use of game design elements in non-game contexts" and is applied not only to education, but also to many other scenarios like health-care or production.

With respect to the educational scenario, the gamification approach is increasingly used for teaching students, training people, engaging users and balancing difficulties and abilities [29–31]. In particular, Barata et al. [32] explored how gamification can be applied to education in order to improve student engagement: they gamified a college course and compared it against a non-gamified one. Results showed that students who attended the gamified course had significant improvements in terms of attention to reference materials, online participation and proactivity. Moreno [33] investigated the gamification of programming and showed that students who used a video game to improve their programming skills, performed 12% better in their final exam than students who did not. Iosup and Eperma [15] experimented a teaching technique that used social gaming elements to deliver higher education: they found that gamification is correlated with an increase in the percentage of passing students, and in the participation in voluntary activities and challenging assignments. Furthermore,