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EXECUTIVE SUMMARY OF THE THESIS

EVOLI Sync – A video-annotation tool to support the live lesson

TESI MAGISTRALE IN COMPUTER SCIENCE AND ENGINEERING – INGEGNERIA INFORMATICA

AUTHOR: GIACOMO CASSANO

ADVISOR: NICOLETTA DI BLAS

ACADEMIC YEAR: 2020-2021

1. Introduction

Starting from the digital age we are experiencing and, in particular, during the pandemic, it was necessary to adopt new teaching models. At the peak of the Covid emergency (mid-April 2020), 91.4% (1.57 billion) of world students in 192 countries were at home. In this period, teaching was initially carried out at a distance and subsequently the concept of a mixed class was developed: a class made up of students partly in the presence and partly at home who participate in the same lesson.

This transition to online mode has negatively distorted the way students interact with each other and with the teacher. Often the lessons are carried out through video conferencing software in which each participant has the possibility to interact only by activating the microphone or webcam. Currently, in fact, teaching in university (especially) is translated into transmissive form, which it is expressed through lectures of the frontal type. Furthermore, the fact that university classes are composed by a large number of students (Johnson et al., 2016) which makes it more difficult to arouse interaction between participants. As it is known, instead, the interaction between teacher and students is fundamental, because it is precisely through the teacher-student feedback and vice versa, that you can monitor the processes and improve learning outcomes (Hattie, 2009; Hattie & Yates, 2013).

The interaction therefore becomes extremely poor and, in particular, the teacher is unable to understand if the students are learning the content of the lesson, if not explicitly indicated. Many times, in fact, if a student does not understand the content, he is not even able to express her doubts and the teacher interprets her silence as a false confirmation of learning.

2. Reducing the distance

What if we try to reduce the distance?

This thesis aims to answer this question by proposing the design and development of a web platform, EVOLI Sync, which consists of a synchronous video-annotation system capable of supporting the live lesson, offering an innovative infrastructure based on the exchange of digital feedback between students and teacher, but also among students, in such a way as to highlight the doubts of the participants at a particular moment of the lesson.

In particular the platform enables a student to select his grade of understanding in each moment of the lesson and the set of students' grades is collected and analyzed in a dashboard visible to the lesson participants. Furthermore, the platform enhances the interaction between the participants providing a chat and the possibility to insert notes tagged to the slides. Hence EVOLI Sync builds, around the lesson, an interface level between students and teacher that allows you to express your learning level quickly and intuitively, providing the teacher with a readable analysis of the progress of the lesson at a glance.

3. HyFlex model

It is important to underline that EVOLI Sync is not exclusive for distance learning, but it is also a useful tool for face-to-face lessons by providing a series of features to record students' doubts and compare with the degree of understanding of other participants.
With this approach, the platform intends to support the synchronous modalities of the so-called HyFlex model, designed by Dr. Brian Beatty for his graduate courses at San Francisco State University in 2005.

Figure 1: HyFlex model

This model is an innovative teaching format that combines a face-to-face instructional approach with online teaching, in which each lesson and activity is offered in person, synchronously online and asynchronously online. The central principle of this model is that teaching must be equivalent, regardless of how it is delivered. The result is a multi-modal experience.
The HyFlex approach provides students autonomy, flexibility, and seamless engagement, no matter where, how, or when they engage in the course. The approach was developed with a focus on student flexibility, but the benefits also extend to faculty. For example, an instructor, along with some students, could "attend" class remotely, while other students join physically from a room on campus.
All participants—irrespective of how they choose to join—must have equitable access to the learning resources, the instructor, and one another. Effective use of classroom strategies and/or technology is vital so that all participants can hear verbal interactions. All of the educational resources must be online, and students typically participate in a chat space along with the live video of the session.
HyFlex courses are very robust in terms of emergency situations, indeed this approach permits to save and continue the courses in all the situations, such that climate changes, natural disasters, earthquakes, wildfires, hurricanes or health crises (COVID-19), in which there is the need to suspend the F2F modality. (Milman et al., 2020)

Figure 2: HyFlex model modalities[1]

4. Goals and requirements

EVOLI Sync is proposed as a tool capable of assisting the synchronous modality of the so-called HyFlex model. The platform offers a tag-based feedback system to support student-teacher interaction during lessons of this type. In this way:

1. Distance students will be able to take advantage of a more complete teaching experience by benefiting from an innovative digital feedback system to

[1] From https://www.flcc.edu/hyflex/

communicate with the teacher and the rest of the class.
2. In-person students will have a tool that brings together numerous features to facilitate interaction with the teacher and understanding the teaching content.
3. The teacher will be able to monitor in real time the progress of student understanding through a system capable of analyzing the feedback and will have a set of functions to better prepare and manage the lesson, normally usable in different environments, in a single ecosystem.

In particular a lesson is visible in a proper page, composed by several elements.

STUDENTS' LECTURE PAGE

The students' lecture page contains the following panels:

- The video player is the YouTube player that shows the live broadcast of the lesson.
- The understanding panel contains a switch with 3 levels from 0 to 2 with which the student can express his degree of understanding related to the current moment of the video.
- The slide presentation is contained in a panel with the commands to change the page, zoom, and return to the slide in which the teacher is.
- The feedback panel shows a pie chart showing the number of students who are understanding 0, 1 and 2, while the line graph shows the percentage of students understanding in the last 5 minutes .
- The communication panel contains: the chat that shows both normal messages and questions tagged to the video, the notes panel that shows the list of notes tagged to the current slide if the slides exist or the complete list of notes if the slides do not exist, the participants panel shows the list of participants of the lesson, with their names and surnames.

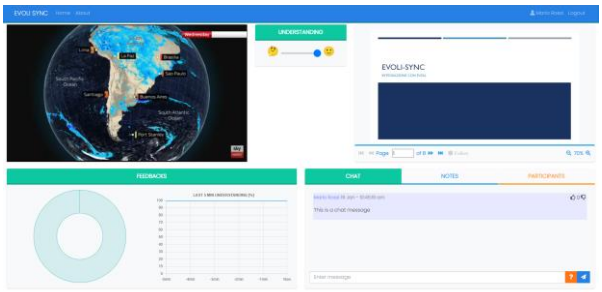

Figure 3: Students' live lecture page.

TEACHER'S LECTURE PAGE

The teacher's live lecture page has some important differences from that of the student. Instead of the understanding switch, there is a control panel that allows the teacher to enable / disable chat, notes and the display of feedback to students. The feedback panel shows a button with which it is possible to see a line graph showing the trend of the student understanding percentage from the beginning of the live broadcast up to the current viewing time.

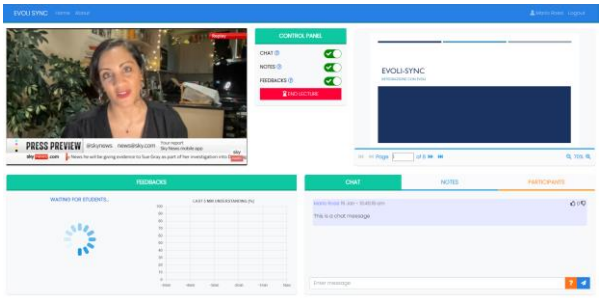

Figure 3: Teacher's live lecture page.

LECTURE REPORT PAGE

After the lesson is finished, its recording is visible in a report page in which each student or teacher can review the video lesson, the slides, the notes and the questions asked during the live class. The notes are collected together in order to build a shared digital notebook with the notes of the whole classroom, that can be downloaded.

The platform also tries to implement its own concept of open courses, in which a user can see not only the recorded lessons but also live lessons without being registered to the course. The teacher, in fact, can open his lesson to a larger audience, making it available to a very wide audience.

EVOLI Sync has the ultimate goal of innovating teaching by applying the benefits of the digital world to live lessons by creating a feedback

interface to bridge part of the gap in online teaching by adding a high degree of interactivity between students and teacher.
EVOLI-Sync is aimed at school contexts of all levels and types, starting from middle school up to university classes.
Furthermore, EVOLI-Sync proposes itself as a lay platform that is disconnected from any school or academic organization. In this way, an individual can register and have a platform available immediately ready for use. It is therefore not necessary to have a company or university account. Consequently, EVOLI Sync can also be used for a non-didactic context, in which any individual wants to discuss a topic with others and wants to take advantage of a feedback system to understand directly what is the "reaction" of his audience.

5. Design and Implementations

EVOLI Sync is a web application that follows the classical 3 tier application model where “tier” has the meaning of logical layer. A 3-tier application architecture is a modular client-server architecture that consists of a presentation tier, an application tier and a data tier. The data tier stores information, the application tier handles logic and the presentation tier is a graphical user interface (GUI) that communicates with the other two tiers. The three tiers are logical, not physical, and may or may not run on the same physical server.

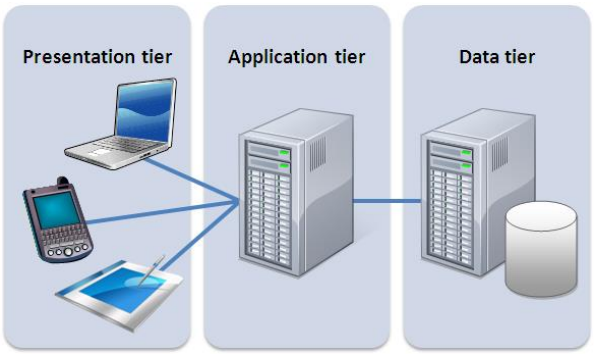

Figure 4: 3 level application.

From a logical architectural point of view, EVOLI Sync adopts the MVC (Model View Controller) pattern, which separates the architecture into software components that implement 3 fundamental roles:

1. The model conceptualizes the various entities involved in the domain
2. The view allows you to create an interface that shows the model data in an appropriate format and allows the end user to communicate with the application logic displays the data contained in the model and deals with the interaction with the end user
3. The controller contains all the business logic and changes the state of the model after receiving the appropriate commands from the view.

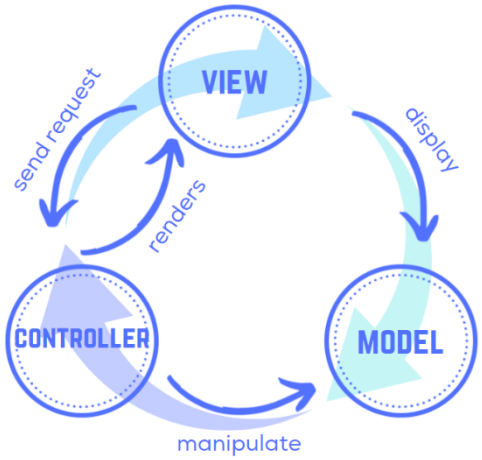

Figure 5: MVC pattern.

During the development of this application, many technologies are used and they can be seen in the following figure:

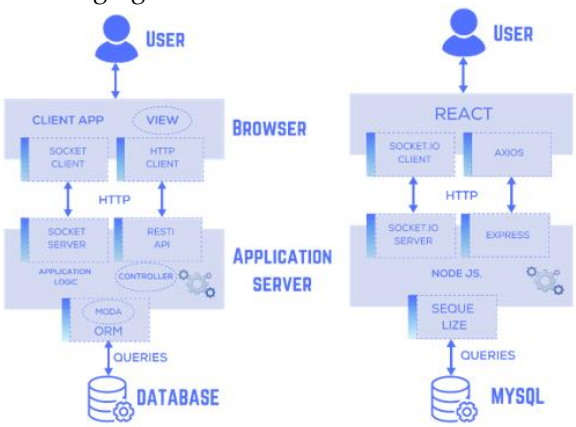

Figure 6: Technologies.

6. Evaluation

EVOLI Sync was tested in a real-life environment, during two lessons of the "Communication & Argumentation" course taught by Professor Nicoletta Di Blas at the Politecnico di Milano. Overall, 74 students took part in the experimentation. The course deals with communication principles borrowed from linguistic sciences, semiotics and argumentation theory. 60 students were on location while 14 were connected from home; not all responded to the questionnaire (which was presented as optional).
The questionnaire entailed 27 questions and required from 5 to 10 minutes for completion. After a first section meant to profile the respondents, it probed the perceived usability and usefulness of the tool. Though administered in the context of higher education, the questionnaire is already set for gathering feedback from users in different contexts and school levels.
The results of the evaluation test shows that the students considered the functionalities of the system clear, giving an average score of 4.13 / 5: sliders, messages, questions, notes and graphs. About two-thirds of the students found it helpful to see other students' level of understanding in the graphs, on the ground that this encourages people to ask more questions if their level of understanding is low and, in general, to understand if low personal understanding is a symptom of personal gaps or lack of attention or it is a general class problem, due to the quality of the explanation. It was also noted that knowing if other students also have difficulty on the same topic encourages a participant to interact by asking questions, reducing the "it's just me" effect. It can be concluded that having a general idea of the understanding of the audience develops greater group interaction. We can conclude that the tests were generally successful, as only a very few students would not recommend using EVOLI Sync in other courses. The students greatly appreciated the central focus of the project, i.e. the exchange of feedback between students and teachers, and in particular it showed that knowing and being able to compare with the level of learning of other students significantly increases the interactivity of the class group.

7. Conclusion and future works

In this thesis we worked on developing an application focused on a video-annotation tool capable of supporting and facilitating communication and the exchange of feedback between the participants of a lesson. We also saw how the application supports two of the three modalities of the HyFlex model.

Starting from the results achieved, it is possible to improve the application with future developments.

The first step to do consists in expanding the tool integrating in EVOLI Sync the functionalities of the previous, asynchronous, annotation tool EVOLI in order to support both the flipped classroom approach and the synchronous teaching. The harmonized tool would allow a complete and innovative platform: it would be capable of supporting any type of lesson (flipped, in presence, remote and asynchronous) offering a complete video annotation system. In this way EVOLI will be able to fully support the HyFlex model.

After the integration between EVOLI and EVOLI Sync, the research will run on two parallel tracks: on one side, the characteristics and pros/cons of the HyFlex teaching will be analyzed through real-life experiments (mainly at POLIMI), on the other, new features will be added to the tool, based on the results of the analysis.

During this thesis, and in particular in the state of the art, we pointed out that, in the world of education, the classic video-conferencing tools such as Google Meet, Cisco Webex Meetings, GoToMeeting, Zoom and Microsoft Teams are used despite none of these tools are born with a didactic orientation. We therefore want to propose to build a plugin for the various systems that has the same functionality of EVOLI Sync as a support to the lesson. That is a system that allows you to insert understanding feedback and notes shared between the students of a lesson and, moreover, that is able to provide the teacher (host of the video conference) with an at-a-glance analysis of the progress of student understanding.

After all, we also want to introduce some minor improvement in the application design, in particular:

- An improvement of the User Interface in order to ensure the best possible user experience for the user. We want to ensure that the graphic interface of the application is analyzed and possibly modified by a web designer. The goal is to make it easier and more intuitive to use the application. In addition, we want to provide the end user a customization of the graphical interface while viewing the lesson so that the user can choose the interface with which to follow the lesson from different screens.
- The creation of a notification system. The user, logged into the platform, will have a notification area in which he will be notified whenever: a new lesson is created, changed or is going to start in one of the courses in which is enrolled, another use answer, like or dislike his chat question or messages.
- The creation of customized dashboards that aggregate and analyze data from a set of lessons, so as to be able to make comparison between multiple lesson and / or courses.

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[1] Johnson, L., Becker, S. A., Cummins, M., Estrada, V., Freeman, A., & Hall, C. (2016). NMC horizon report: 2016 higher education edition (pp. 1-50). The New Media Consortium.
[2] Hattie, J. (2009). Visible Learning: a synthesis of over 800 meta-analyses relating to achievement. LondonNew York. NY: Routledge.
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[4] Milman, N., et al., (2020). 7 things you should know about the HyFlex Course Model.

Acknowledgements

A conclusione di questo elaborato, desidero ringraziare tutte le persone, senza le quali questo lavoro di tesi non esisterebbe nemmeno.

In primis ringrazio la mia relatrice Nicoletta Di Blas, per avermi seguito e supportato in questi mesi di lavoro e per essere sempre stata un sostegno umano e gentile con cui condividere idee e progetti futuri.

Ringrazio la mia famiglia:
- I miei genitori per avermi supportato moralmente ed economicamente, per l'infinita pazienza, per essere stati un sostegno stabile e non un peso e per aver creduto nelle mie capacità più di quanto ci credessi io. Mamma, so che starai piangendo mentre leggi queste righe, ce l'abbiamo fatta.
- Mia sorella per il sostegno emotivo e i confronti in ogni momento di crisi
- Mio fratello per essere sempre stato il mio punto di riferimento
- Tutto il resto della mia famiglia allargata, semplicemente per essere così come sono

Ringrazio la mia fidanzata Bea per esserci stata dal giorno 0 di questo percorso e per conoscermi meglio di quanto mi conosca io stesso.

Ringrazio i miei amici e colleghi Silvano e Antonio per avere condiviso con me amicizia, risate, gioie e fatiche di questa avventura di 5 anni.