AN E-LEARNING PLATFORM ADAPTED TO THE ONLINE LEARNING SYSTEM

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Introduction

- Even before the COVID-19 pandemic, the demand on the e-Learning solutions was in continuous growth and was adopted widely by schools, universities and other educational institutions as well as by individual people exceeded.
- The COVID-19 pandemic made the demand on the e-Learning solutions even higher and forces people worldwide to rely on those solutions as the only way that allows the learning process to continue, especially in the countries that are severely affected by the pandemic.
- According to UNESCO, this situation affected more than 1.5 billion children which represents 74% of total enrolled learners worldwide.

Proposed Platform (1)

- The proposed platform not only enables students to continue their learning process at home but it enriches the learning experience.
- The learning platform integrates different learning resources (e.g. books, laboratories, educational games, quizzes).
- The platform has two types of accounts: the teacher-account and the student-account.
- The platform is multilingual (it supports English and Romanian languages with the possibility to be easily extended).
- The platform integrates a multimodal interface that supports speech and touch-based commands. It generates visual and phonetic outputs.

Proposed Platform (2)

- The interface integrates different customisation features such as the possibility to customize the colours used in the interface, the font, the text size and the language from the setting page.
- In addition, the platform integrates some adaptive features that are based on the information that are extracted from the profile of each user, such as the adaptation of the:
  - design and content according to the grade of the student and his/her preferences,
  - quizzes level according to the knowledge level of the student in the topic (excluding the quizzes initiated by the teachers),
  - levels and/or durations of some physical exercises according to the physical condition and previous performances of the student.

Proposed Platform | Teachers

- The platform enables teachers to:
  - easily add new learning resources and to manage the access to these resources (for a specific student, group of students, class, all students).
  - visualise in real time the performance of their students and to provide live guidance or feedback.
  - initiate collaborative or competitive quizzes for a selected group of students as well as to communicate with the students.
  - track the evolution of each students but also the evolution of a group of students and the whole class.
- During classes, the platform can notify teachers about the emotional status of their students.

Proposed Platform | Students (1)

- The platform enables students to easily ask for new learning resources from their teachers.
- In addition, the platform monitors the emotional status of the student and suggests different activities according to his/her emotional status.
- It stimulates:
  - the interaction between students and their teachers,
  - the interaction between the students themselves,
  - the physical activity of the student by recommending the execution of physical exercises and offering rewards (e.g. an additional point, remove an absence, a bonus hint) for each activity.

Proposed Platform | Students (2)

- Stimulation of the physical activity of students:
  - daily, on the beginning of the first class, the students will execute multiple indoor physical exercises that are provided through a game on the platform.
  - the level of some exercises and its duration will vary between students since for each student those will be adapted according to the profile of each student and his/her previous performances.
  - during the execution of the physical exercises, the platform tracks the evolution of the student and provide at the end of the session a feedback regarding the performance of the student.

Emotion Recognition Implementation

- The platform recognizes the emotional state of the students by tracking their facial expressions.
- Through the camera of the device from which the user is accessing the platform, the platform tracks and records the face of the user continuously.
- From each recorded video, video-frames are extracted then sent to the Microsoft Azure Face API in which those frames are analyzed.
- The Azure cloud sends back a JSON file that contains the result of the recognition, as illustrated in Figure 1.
- By comparing the recognition confidence rate of each emotion in the received JSON file, the platform deduces the current emotion of the user.

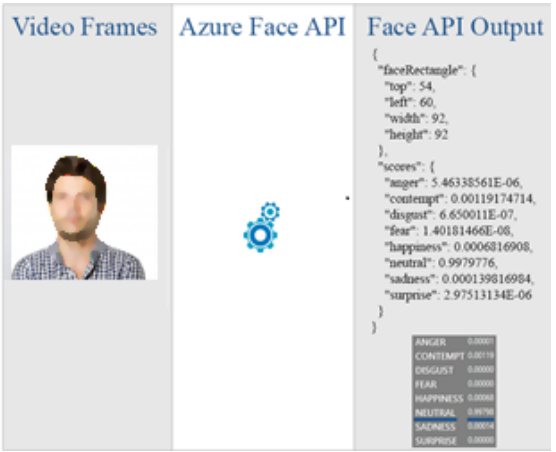

Figure 1. Emotion Recognition.

Physical Exercises Implementation (1)

- The application that contains the physical exercises is implemented using Unity 3D engine.
- A set of physical exercises with different difficulty levels were recorded by professional trainers.
- The platform tracks the evolution of the student during each physical exercise through the camera of the device.
- It evaluates and scores the evolution of the student in function of the degree of similarity between the movements that were recorded by a trainer *(reproduced on the screen by the trainer-avatar)* with the ones that are being made by the student *(reproduced on the screen by the student-avatar)* as illustrated in Figure 2.

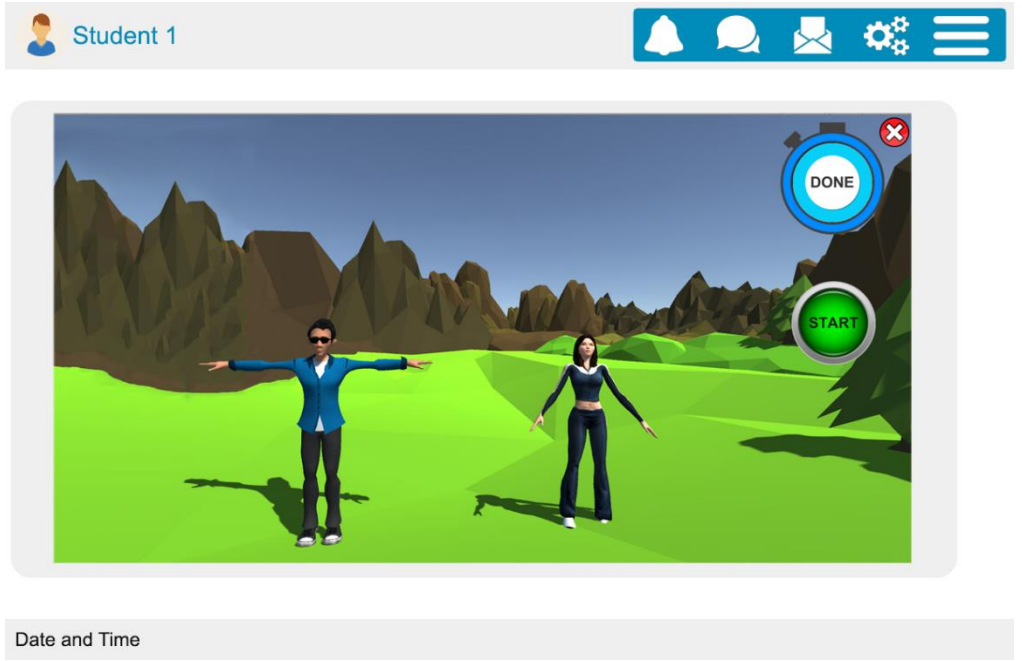

Figure 2. Screenshot of a physical exercise.

Physical Exercises Implementation (2)

- The evaluation is based on:
  - the human skeleton obtained from images using OpenPose to evaluate the movements,
  - the Dynamic Time Warping algorithm to calculate the minimum distance between the two movements-series,
  - the calculation of the arithmetic mean of distances between each two corresponding joints to compute the similarity between two sequences of frames.

Evaluation

- The voice module has been evaluated by 18 people in the laboratory:
  - for both languages, each user gave twenty-five voice commands for the platform. A total of 900 interactions were recorded (450 for each language).
  - the obtained results are very satisfying for both languages.
- The emotion recognition has been evaluated by the same people also in the laboratory:
  - during the tests four emotions were evaluated: neutral, happiness, sadness and anger.
  - each user mimicked each emotion ten times.
  - a total of 720 interactions were collected (180 for each emotion).

Evaluation | Voice Module (1)

- Some results of the ASR test results:

Language	Command Number	Users' command	Average Recognition Percentage (%)
English	En1	What do I have on my agenda?	96.43%
	En2	What time is it?	96.43%
	En3	What physical exercise should I execute?	92.86%
Romanian	Ro1	Ce am pe agendă?	89.29%
	Ro2	Cât este ceasul?	92.86%
	Ro3	Ce exercițiu fizic ar trebui să execut?	85.71%

Evaluation | Voice Module (2)

- Some results of the NLU, DM and TTS tests results:

Command Number	Recognized intent (% of recognition)	Recognized entity(ies) (% of recognition)	DM Output & TTS (User Satisfaction %)
En1	get_info (100)	schedule: agenda (100)	92.86%
En2	get_time_date (92)	time: time (96)	100.00%
En3	do_phy_exe (98)	phex: physical exercise (98)	100.00%
Ro1	get_info (98)	schedule: agendă (98)	82.14%
Ro2	get_time_date (88)	time: ceasul (92)	96.43%
Ro3	do_phy_exe (95)	phex: exercițiu fizic (96)	100.00%

Evaluation | Emotion Recognition

- The evaluation results for the emotion recognition:

Emotion	Neutral	Happy	Sad	Anger
True Detection	169	175	158	155
False Detection	11	5	22	25
Detection Rate	93.89%	97.22%	87.78%	86.11%

- The confusion matrix for the emotion evaluation results

Emotion	Neutral	Happy	Sad	Anger
Neutral	169	1	8	2
Happy	3	175	0	2
Sad	15	0	158	7
Anger	6	5	14	155

Conclusions

- An e-Learning platform that enables school students to continue their learning process at home and enhances this process was developed.
- The platform stimulates the physical activity of the students, tracks their evolution during the physical exercises and provide feedbacks about the evolution of each student.
- The platform tracks the emotional status of students and suggests activities according to the emotional status of each student and it informs teachers about the emotional status of their students during classes.
- The platform allows teachers to add new learning resources, to manage access to those resources, to visualize in real time the evolution of each student, to provide guidance and to track the evolution of a specific student or group of students.
- The platform supports English and Romanian languages and integrates a multimodal interface that has many adaptive and customizable features.
- The levels and the duration of the games and quizzes (excluding the ones initiated by the teachers) are adapted according to the information that are extracted from the profile of each student.
- The obtained results of the evaluation process are very satisfying.

Future Work

- Extend the languages that are supported by the platform.
- Extend the targeted users of the platform.
- Enrich the materials that are available on the platform.
- Develop additional adaptive and customizable features.
- Extensive field trials are planned with teachers and students to evaluate the platform together with all its features as a single solution.

Acknowledgements

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Thank You!