AN E-LEARNING PLATFORM THAT SUPPORTS PERSONALIZED LEARNING AND MULTIMODAL INTERACTIONS

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Introduction

- Within the first two decades of the third millennium, the evolution of e-Learning exceeded all the expectations and it converted fast from a useful tool to an indispensable tool that should be available in schools, universities, any other educational institutions and workplaces.

Picture source: https://sales-academy.net/fortune-500-companies-using-elearning-productivity

Proposed Platform (1)

- The proposed platform aims to enhance the learning process of the primary school students and to allows tutors/parents to track the evolutions of their students.
- It has four types of users: *administrator, tutor, student, parent*.
- The platform is multilingual, it supports *English and Romanian languages* with the possibility to support new languages.
- It can be accessed from any device or platform.
- The platform integrates a multimodal interface that integrates three modules: *Graphic User Interface (GUI), Voice and Touch-based commands modules*.

Proposed Platform (2)

- Based on the information extracted from the profile of each user (knowledge level by topic, performance history by topic, preferences, etc.) the platform automatically generates groups of students for specific topics.
  - The groups are created using K-means algorithm that uses as properties the level of the user, their preferences and their previous performances.
  - The previous performances are measured as the mean score for the last month.

Proposed Platform (3)

- Once a student register to a new topic:
  - The student will be asked to perform a quiz to find out the level of the student at that topic and what types of content suit better the student for the topic.
  - Then according to his/her profile and performance, the platform based on the evolutions of previous students that had similar profiles and similar initial quiz performances, will generate and suggest a learning plan to the student.

Proposed Platform | Students

- The platform enables ***students*** to:
  - easily access different useful educational resources that are integrated into it, such as photos, videos, animations, quizzes, educational games and virtual laboratories,
  - review the materials that were explained in the classroom,
  - join a class,
  - visualize their grades, their history,
  - useful notifications and periodical reports.

Proposed Platform | Tutors

- The platform enables ***tutors*** to:
  - manage and create different educational materials, to control the access to these materials,
  - create classes, to add or remove students to the class and to manage the access to the class,
  - create different groups of students and initiate competitive quizzes between students of the same groups or competitive collaborative quizzes between the different groups,
  - track the evolution of their students, to visualize their grades, their history and different periodical reports.

Proposed Platform | Parents & Administrators

- The platform enables ***parents*** to:
  - track the evolution of their children,
  - visualise their grades, their interactions with the tutors and different periodical reports regarding the evolution of their children.
- The platform enables ***administrators*** to:
  - manage different aspects of the platform.

Proposed Platform | Adaptive Features

- The platform integrates different adaptive features such as:
  - the adaptation of the quizzes level according to the knowledge level of the student in the corresponding topic (beginner, intermediate and advanced) and according to his/her previous performances,
  - the adaptation of the content (e.g. educational resources, avatar, etc.) according to the preferences of the user (e.g. learning preferred type of the content: visual, auditory, kinesthetic and tactile, language, etc.) and/or his/her emotional status.

Proposed Platform | Customisable Features

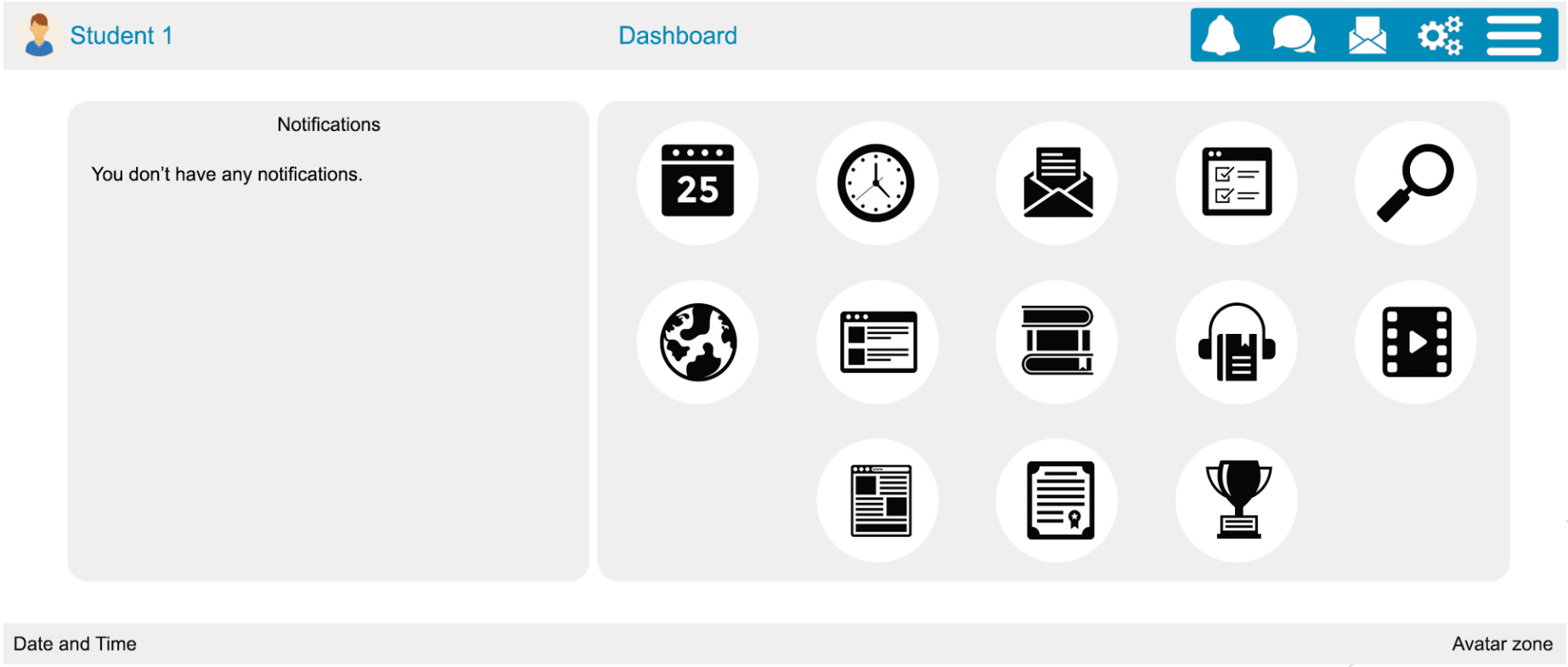
- The platform integrates different customisable features such that can be modified by each user such as:
  - the character of the avatar,
  - the presence of the avatar (activate/disactivate),
  - each of the adaptive features (activate/disactivate),
  - the language of the platform,
  - the preferred colours,
  - the preferred icons.

Proposed Platform | Interface

- The platform integrates a multimodal interface that integrates three modules:
  - ***Graphic User Interface (GUI)***: it allows the users to navigate smoothly through the different pages/functionalities of the interface/platform.
  - ***Voice commands module***: it enables the user to interact with the system through speech commands.
  - ***Touch-based commands module***: it enables the user to interact with the system through touch-based commands.

Proposed Platform | Interface | GUI

- The GUI is fully responsiveness and works across the different platforms and devices. It was developed using HTML5, CSS3 and JavaScript.



The main page of the platform (student version).

Proposed Platform | Interface | Voice Commands Module (1)

- The Voice Commands Module is composed from 5 components:
  - ***Audio Preprocessing***: extracts useful fata for the module.
  - ***Automatic Speech Recognition (ASR)***: transforms the voice commands of the user into a text.
  - ***Natural Language Understanding (NLU)***: extracts the meaning of the user's input in natural language.
  - ***Dialog Management (DM)***: decides what action should the system takes.
  - ***Text-to-Speech (TTS)***: transforms the written text into an artificially spoken audio file.

Proposed Platform | Interface | Voice Commands Module (2)

- Used Solutions:

Component	Used Solution
Audio Preprocessing	Personal implementation
ASR	Google Speech-to-Text Service
NLU	RASA X
DM	RASA X
TTS	Google Text-to-Speech Service (for English) ResponsiveVoice.JS API (for Romanian)

- Module Architecture:

Proposed Platform | Interface | Touch-based Commands Module

- It is formed from two components: the data acquisition component (DAC) and the data processing component (DPC).
  - DAC collects the users' touch-based commands through.
  - DPC processes the data collected by the DAC. Some commands are executed directly by the device itself while other commands are sent to the platform.
  - To recognize the touch-based commands, the module uses the Hammer.js library.
- Module Architecture:

Evaluation (1)

- During the last few months, the platform has been evaluated in the laboratory on different devices (computer with touch-enabled screen, Samsung Galaxy Tab 4 tablet and iPhone 8 phone) by:
  - a group of 10 people aged between 30 and 35,
  - a group of 14 children aged between 8 and 14.
- For each language 30 different voice commands were used to evaluate the different components of the voice module. During the evaluation, the children evaluated the module using the Romanian language only while the adults evaluated the voice module using the Romanian and English languages. They repeated the same command twice.

Evaluation (2)

- Some results of the ASR test results:

Language	Command Number	Users' Command	Average Recognition Percentage (%)	
			Adults	Children
English	En1	I want to do a physics exercise	95.00	N/A
	En2	Tell me my grades	100.00	N/A
	En3	Show me the grades of Andrei	85.00	N/A
Romanian	Ro1	Vreau să fac un exercițiu de fizică	90.00	85.71
	Ro2	Spune-mi notele mele	95.00	82.14
	Ro3	Arătă-mi notele lui Andrei	90.00	85.71

Evaluation (3)

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

Command Number	Recognized intent (% of recognition)	Recognized entity(ies) (% of recognition)	RASA X Output and TTS (TTS User Satisfaction %)
En1	do_exercise (95)	subject: physics (100)	Action: display a physics exercise (N/A)
En2	get_grades (100)	action: tell (100) person: none → me (100)	Action: display and read the grades of the user (95)
En3	get_grades (100)	action: show (100) person: Andrei (95)	Action: display the grades of Andrei (N/A)
Ro1	do_exercise (96)	subject: fizică (98)	Action: display a physics exercise (N/A)
Ro2	get_grades (100)	action: Spune-mi (100) person: mele (98)	Action: display and read the grades of the user (96)
Ro3	get _grades (98)	action: Arătă-mi (100) person: Andrei (96)	Action: display the grades of Andrei (N/A)

Conclusions

- A platform to enhance the learning process of the primary school students was developed, it allows tutors/parents to track the evolutions of their students/children.
- The platform supports English and Romanian languages, integrates different adaptive features and can be accessed from any device.
- The design of the graphical user interface was very appreciated by the users on the different devices that they have used to accessed the platform (computer with touch-enabled screen, Samsung Galaxy Tab 4 tablet and iPhone 8 phone).
- The possibility to interact with the platform through speech commands was appreciated by the users.

Future Work

- Integrate other languages into the platform as well as to develop more adaptive and customizable features.
- Extend the targeted users of the platform in such way that the platform targets all the students from the different educational levels and any person that want to learn something.
- Enrich the different materials that are available in the platform.
- Extensive field trials are planned for the near future and the final test will evaluate the platform together with its features as an integrated solution.

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Thank You!