

VirtuaLecto Storytelling Content Creation Platform Using Augmented Reality and Virtual Reality

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Abstract. In recent years, technologies such as augmented reality and virtual reality have not only bridged the digital and real world, but have also become involved in education as part of immersive experiences, supporting the student's learning process. This research work shows the advances in the development of a digital platform called VIRTUALECTO, in which teachers can create content with augmented reality and virtual reality to reinforce learning activities that allow students in an interactive, educational way and immersive to improve reading skills, through the use of mobile devices. The results, so far, indicate that the proposal guarantees a virtual learning environment (VLE), within the ISO 25000 [1] quality standards, in addition to having some improvements compared to other similar proposals for storytelling.

Keywords: Augmented Reality · Virtual Reality · Virtual Learning Environment · Micro-services · Web Server · Application Server.

1 Introduction

Currently, technologies have become a very important tool in teaching and learning processes, as part of their advantages of modern education, and students compared to traditional education are no longer mere recipients of information [2]. At an early age, children interact with new technologies in their learning, as devices are increasingly used in their education and make this more funny with the help of videos, slides, online platforms, virtual and augmented reality [3].

Augmented reality (AR) and virtual reality (VR) are one of the emerging technological tools that have been gaining popularity in recent years. Its trend is increasing in relation to its application in the educational field, since they allow users to have an immersive experience, visual three-dimensional simulations combined with audio, superimposing virtual elements on reality, allowing them a greater understanding of a specific topic [4] [5]. There are some tools for Storytelling, the best known case is *StoryBird*. In addition to the fact that the vast majority of this type of tools are focused only on narrative texts, using only audio-visual resources, but now they are being supported with technologies such as augmented reality [6].

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In the present research work is shown the progress of creating a platform for storytelling, and interactive Virtual Learning Environments for content creation with augmented reality and virtual reality.

2 Related works

Recent studies aim to use virtual reality and mobile applications to improve the experience in education. ARVEE seeks combining traditional and immersive education in an interactive, fun and educational way, encouraging students to learn astronomy and motivation to pursue a career similar to the one they are learning. The project was tested in a group of students between 7 and 14 years of age, where a great acceptance was observed for this technology. In addition, 90.9 % of them consider that virtual reality can be of great help in the learning process and make some school subjects more interactive and easy to understand [2].

Previous studies investigated about the use of augmented reality Game-Based Learning, that enriching students, experience during reading comprehension activities, its purpose is the design a game using Augmented Reality in order to promote understanding in primary school students, the tests included students from third to sixth grade, between the of 8 and 12 years old. With the help of teachers, a game called *AR Ole Cierraajos* was developed for tablets and smartphones with Android, the game is inspired by pop-up books and works using AR markers represented on each page of the book. Hendry concluded that the results of reading comprehension with the game show no difference with the results of traditional approaches, however, the students show a greater motivation and interest in the activity [7].

at present there are investigations that Comparing reading comprehension between children reading augmented reality and print storybooks, measured the reading comprehension of children who read a storybook in augmented reality and They compared it to others reading the traditional print version of the same story. To animate the book with augmented reality, the *HP Reveal Studio* platform was used to create 2D animations with the help of images and audio materials, and show them on the pages of the book. Delneshin, concluded that the application with AR content has a positive influence on readers, and observed or a significant difference compared of the traditional method [8].

Other studies investigated about Virtual Reality, and the develop of an integration in the learning environment for education, which was developed a simulation platform to teach the water cycle to children, using COSPACES VR and its MERGE Cube complement. With the CoSpaces creation tools, it is easy to build 3D scenarios, students interacted with 3D objects and models. Ahmed concluded that using VR enables the user to feel more personally connected to their environment and helps them learn more effectively [9].

3 Proposal

3.1 Theoretical framework

Augmented reality (AR) It is a way of Augmenting the real world with virtual objects, it consists of combining real and virtual objects in a real environment and in real time. AR technology has been applied to a wide range of fields: tourism, entertainment, marketing, surgery, logistics, manufacturing, maintenance, and others [10].

Virtual reality (VR) refers to an entire simulated reality, which is built with computer systems using digital formats. Building and visualizing this alternate reality requires powerful enough hardware and software to create a realistic immersive experience (for example, virtual reality headsets or dedicated glasses and 3D software) [11].

Storytelling Digital storytelling has been widely adopted in teaching and learning in educational sectors around the world. Digital storytelling is regarded as the art of telling stories with digital elements including text, graphics, sound and video. A typical digital story is a few minutes long narration with video and music to present ideas on a certain theme. [12].

React Native React Native is a native scripting framework for cross-platform mobile development. The framework was originally developed by Facebook and released in 2015 for iOS only, but an active community has since added Android support and done many other contributions to the open source project. [13].

3.2 Objective of the platform

The objective of the platform is the creation of educational storytelling content, with augmented reality and virtual reality technologies, to improve reading comprehension, as a motivating effect, our target audience is teachers, who will be able to create content with AR, VR and activities for student evaluation from a web platform, the other target audience is the students, who will be able to consume these resources, through a cross-platform mobile application.

3.3 Platform architecture

Due to the special characteristics of the proposal, there are two client applications, both for content generation and for consuming mobile learning objects. An architecture is proposed that finds a balance both in design and the development of the different components that compose it. This work propose to divide into two parts, server and client side.

Server Side Considering the demand for data storage and transfer in the flow of the platform, it is necessary optimal requirements of the server side. That is why the trends in architectures based on microservices are taken as a base, which, unlike monolithic

architectures, allows a better use of the services provided by the cloud [14]. This model considers two main modules, a database module with *PostgreSQL* as the main database and *DigitalOcean Spaces* as the file storage system, and a Services module in Django system on Docker containers as see Fig. 1.



Fig. 1. Communication. Between the web server and the application server

- **Database** PostgreSQL is a relational and object-oriented database manager. It is considered among the most powerful relational database management systems, provides simple accessibility, is cross-platform, and is available for use on all major operating systems without compromising its performance [15]. However, it should be considered that it is easy to violate without the appropriate protection settings, another important point to consider is its small amount of data types, as see Fig. 2
- **File system** DigitalOcean spaces is a file storage, service that allows you to store large amounts of files. The data transfer is protected by *HTTPS*, and the scalability of the storage is simple, so its consumption is optimal and safe.



Fig. 2. Communication. Between the web server and the application server

Web services application : Django is a very powerful and popular web framework, which helps to effectively launch web applications implemented on Python. Features like its relational object mapper, Python API, and admin interface make it securely efficient in web development [16].

Usually, applications running on a platform, either on production or development, use a server to respond to a request of the client, the Django framework uses its own execution server to deliver content whenever a request is made [17].

Although this works good, it is not advisable to use this development server to run a production environment, so for this proposal Green Unicorn was thought for the communication between the application server and the web server, as shown in 2.

Client Side Client-side applications are those that can be operated by both web browsers and applications on mobile devices, generally are not well compatible with current technology. These applications not only need to share data remotely, but also cache and update data locally to continue responding to user requests through their interaction [18]. Existing cloud databases only provide remote data that is shared and the need arises to implement caching and buffering to application level [19]. In addition, on the client side, information processing is quite fast, allowing very complex tasks to be carried out, allowing applications to be very flexible and personalized.

In Fig. 3, the client-side architecture proposal for the mobile application is shown, which has several modules that help the generation of 3D digital scenarios, to create both Augmented Reality and Virtual Reality.

- **Object Learning Reader Module** : This module is responsible for reading the learning objects, which come as a query from each user in JSON format, which contains a set of metadata, which provides us with information such as: Title, Description, Creation Date, Object Type learning (AR or VR), Positions of the 3D models, Path of the 3D models, Keywords. All this information will become object data, which can be interpreted and processed by the client application.
- **3D Scenes Creation Module** : This module is in generates the different scenarios, based on the learning objects that were read in the previous module. This module is responsible for assembling resources that can compose a 3D scene, and prepare them both to become available in cache and buffer, to allow subsequent rendering, and it is very important the role of the graphics processor of each mobile , to optimize its correct operation and display.
- **AR and VR Rendering Module** : The most important part for the visualization of the 3D models is the present module, since from the creation of the 3D scenarios and already pre-loaded in cache memory, it is that we work with different technologies that have the same objective, create real or virtual situations, such as *ViroReact* open source library, which allows to create augmented reality such as AR Core for android and AR kit for iO's, and for virtual reality creation Google Virtual Reality SDK [20].

Fig. 4 shows the client-side architecture of the scenario creation platform and learning objects.

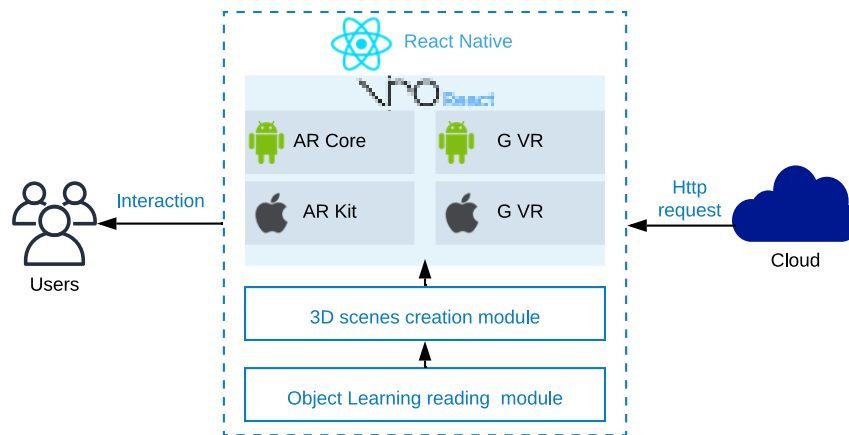


Fig. 3. Client side architecture proposal for mobile

- **Creation Object Learning Creation Module** This module allows us to create learning objects, which is made up of resources for immersive activities such as augmented reality and virtual reality, in addition to creating a set of questionnaires to verify the student's learning process. This module is supported by JavaScript technologies such as Three JS and WebGL, which allows us to build 3D scenarios.
- **3D Models Library** This library contains 3D models that allow different 3D scenes to be assembled with them, these models are categorized into: People, Nature, Buildings, Animals, Objects, which allows to help in the scene assembly process.
- **Audio visuals resources library** This library contains resources such as audio, videos, 360 videos, as part of the modeling of Storytelling scenes.

3.4 Features

Mobile application To measure reading comprehension, the following functionalities were proposed for the application:

- **Login:** The application has a validation to save the information and the user's progress Fig. 5
- **Library:** It is a view where all the stories available to the user are shown, each story has a list of chapters and each chapter has a questionnaire about that chapter.
- **Questionnaire:** It is made up of questions of different kinds. There are four types of question, *simple selection*, *multiple selection*, *true or false question* and *drag-gable questions*. as seen in Fig. 5
- **Reward:** If the questionnaire is successfully completed, a virtual reality view will be shown Fig. 6 or augmented reality Fig. 5 with 3D objects in relation to the selected story.

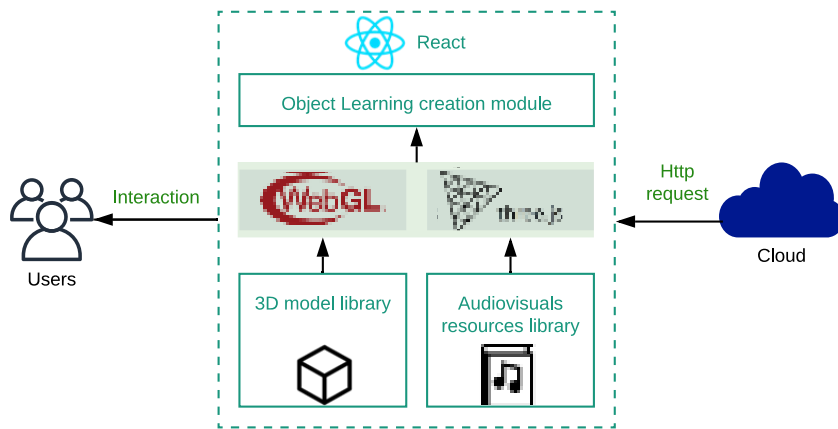


Fig. 4. Client side architecture proposal for mobile

- **Workgroups:** The user will be able to enroll in a work group and thus access new stories and see objects in augmented or virtual reality

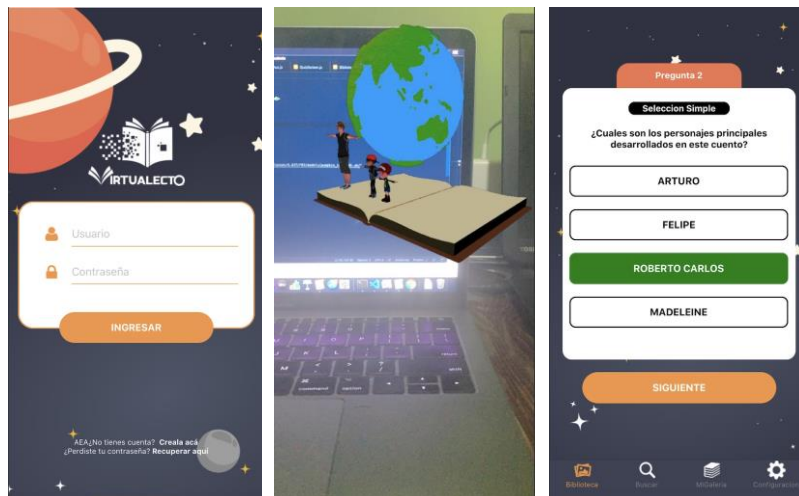


Fig. 5. Validation and simple selection question



Fig. 6. Virtual Reality.

Web application One of the main functionalities of the platform's client, we have the creation and display of content, and user interaction follows the same pattern as the mobile application. In the Fig. 7 show the Scene Editor

- **User login and registration** They can register and login in the web interface.
- **Contents library** In this module users can browse and view descriptions of learning objects.
- **Content creation module** Allows users to create their own storytelling material, as well as providing the ease of using objects, stages and sounds available in the platform's database, as well as their own that have the possibility of being imported.
- **Rendering module** allows to visualize and evaluate the quality of the content created, this feedback allows to have a better perspective of the material that is being built.

4 Evaluation of the platform

The ISO 25000 standard is called Software Quality Requirement Evaluation (SQUARE), it provides a guide for the use of the new series of international standards, called Requirements and Quality Assessment of Software Products (SQuaRE); which constitute a series of standards based on ISO 9126 and ISO 14598, and its main objective is to guide the development of software products with the specification and evaluation of quality requirements, allowing to define the quality model and the process to follow to evaluate said product, establishing criteria for its specification, its measurement and its evaluation [21]. The usability of VLEs can be evaluated in two different contexts: usability during the development process and usability evaluated by end users, that is, when the VLE is found as a finished product. This article will focus on determining the characteristics or aspects necessary for the evaluation of VLE as a final or

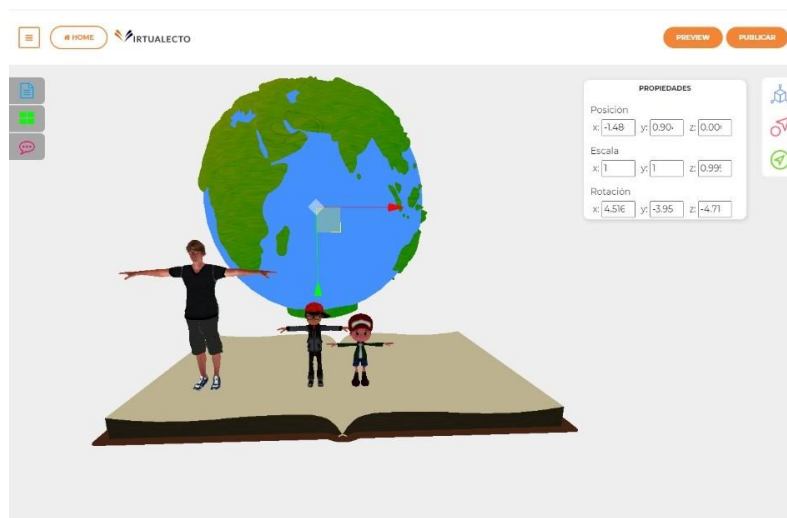


Fig. 7. Scenes Editor.

finished product, for which some characteristics are defined that an VLE must have according to product-oriented standards [1].

We use ISO 25000 as measurement tool, for which it will be applied in the Virtual Learning Environment called VIRTUALECTO, for this we will give a star-based evaluation where the minimum is 1 and the maximum 5, these evaluations were carried out by experts in software development and specialists in educational technologies.

Table 1. VIRTUALECTO platform evaluation under ISO 25000

Cod	Feature	Point
1	Ease of Learning	*****
2	Ease of Understanding or Understandability	****
3	Ease of use and operability	*****
4	Help facility	***
5	Technical accessibility	*
6	Degree of attraction or attractiveness	*****
7	Adherence to standards or conventions or complicity	****

As we can see, the proposed VIRTUALECTO, largely complies with ISO 25000 standards, it should be noted that this standard is based from the point of software engineering.

In the analysis and research carried out on the most similar platforms, which create both augmented reality and virtual reality content, and which are focused on education with the area of communication, the platforms, CoSpaces, Augmented, and Storybird

were found, below The comparative table of the characteristics of the platform proposal is shown, with respect to the other content platforms. In the Table 2 show the comparative.

Table 2. Comparison of VIRTUALECTO with other platforms

	VIRTUALECTO	CoSpaces	Augmented	Storybird
Augmented Reality	Yes	No	Yes	No
Virtual Reality	Yes	Yes	No	No
Education	Yes	Yes	No	Yes
Reading	Yes	No	No	Yes
Recommendation systems	Yes	No	No	No
Questionnaires	Yes	No	No	Yes
Cross-Platform	Yes	Yes	No	Yes
Web Editor	Yes	Yes	No	Yes

5 Conclusions

This research works on the storytelling content creation platform called *VIRTUALECTO*, developed with a set of tools that allow creating a scene editor with 3D models with technologies such as Threejs, React, WebGL. In addition, the proposal also shows us a robust architecture for the rapid creation of this AR and VR content with the use of cross-platform technologies such as ViroMedia. The proposal uses in its development standards for software such as ISO 25000, focused on educational platforms, from a product perspective, as well as where the strength lies in the ease of learning, operability, attractiveness and ease of understanding. In addition, it shows the set of architectures and technologies to give you the support and high demand for information exchange when using big data such as 3D objects, and audio-visual resources.

6 Acknowledgments

Special acknowledgment to the Universidad Nacional de San Agustín de Arequipa, UNSA that through the Grant contract IAI-005-2018-UNSA of the project “Animación a la lectura con M-Learning, creando situaciones reales y virtuales”, is that it was possible to carry out the investigation of the proposal proposed in this article.

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