InglesAR - A Collaborative Augmented Reality Game for English Practicing

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***Abstract*—English has become an international language and its study is very important. Games offer the necessary playful factor, being able to stimulate study. Augmented Reality (AR), in addition to encouraging the student, contributes to the assimilation of content. Therefore, a game for English practice was developed, mixing games and AR concepts. In the proposed solution, children can choose from two different gameplays: practice and challenge mode. In addition to it, the game platform also offers an upload mechanism that allows files to be sent to the application, making it collaborative and expandable.**

***Index Terms*—Augmented Reality, Collaborative Game, Education, English language.**

I. Introduction

With globalization, the English language was disseminated in several countries, becoming an international language and having a strong role in various professional fields [1]. In 2019, it was accounted around 1.5 billion English speakers, most of whom are non-native, that is, they have English as a second language [2].

Therefore, auxiliary tools that facilitate the English teaching to foreigners are important and technology can be one of those tools, once it brings new approaches and methods, which allow greater integration of students and help them in acquiring the language skills.

For example, communication platforms allow the foreign students to chat with native speakers, multiplayer online games may provide linguistic and cultural immersion, Artificial Intelligence can be used in the machine translation, softwares with Virtual Reality (VR) or Augmented Reality (AR) may create a three-dimensional (3D) virtual environment to assist in teaching, enabling greater interaction between user and contents [3].

In childhood education, it is necessary that employed tools are also playful, because the children distracted very easily, so they need different stimulus to keep their focus and attention. Games are one of the options that could be used and they have a special role in any foreign language teaching, especially when teaching vocabulary. There are several techniques to teach this. One of the strategies is using real objects, because, the associating a word with a object, facilitates memorization and consequently learning [4].

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This can be done more easily using AR technology, that, in education area, can be employed as a supplementary tool that allows explore actively the contents, increasing learning motivation and facilitating the understanding and interaction with several objects, components, elements and concepts. Through it, the students can view in a 3D scene: chemical bonds, parts inside human body, inner workings of computers, abstract concepts, complex spatial relationships, etc [5].

One of the problems that impedes greater use of this technology in the academic environment is its rigid structure. Most systems do not adapt to teachers and students needs [5]. Therefore, it is necessary develop a mechanism more flexible, that allows the expansion of the content.

Considering the importance of English language, as well as the application of playful and technological tools in the teach, this work presents the design and construction of a game to practice English vocabulary through Augmented Reality. The principle of the game is identify the correct card corresponding to English word displayed on the screen, being that the cards are the base to project the 3D virtual objects. The project's differential is the ability to expand the vocabulary with the help of the users, who can contribute to the game by sending new components to it.

The rest of this document is organized as follows. Section II brings the literature review. This work's proposal is presented on Section III; Finally, section IV brings the conclusion from this study and the suggestions of future works.

II. Literature Review

A. Augmented Reality

AR is a technology that enhance the reality, allowing optimize the human computer interaction. Its application is wide, being used in areas such as Medicine, Entertainment, Engineering, Education, among others [6]. According to Azuma [7], the three pillars of this technology are: combination of real and virtual content, interaction in real time and objects in 3D.

These characteristics set the technical requirements of an AR system: it needs a screen that can combine real and virtual images, a computational system to process data and respond to user in real time and a tracking system to locate the real base where the 3D virtual objects will be rendered [6].

The first known AR prototype was developed in 1968, in Harvard University. Ivan Sutherland and Bob Sproull created the head-mounted display based in cathode-ray tube and with mechanical tracking system, which later was replaced by an ultrasonic system. Although primitive, the project met the three established requirements by Azuma, creating 3D graphics that seemed to be overlaid on the real world [6].

The known subsequent designs were developed for aeronautic applications [6]. After these projects, countless others appeared in different areas and the AR application was expanding, gaining momentum in this new era, the digital age.

B. Related Works

Lee et al. developed a mobile application for children whose objective is to teach words in English through different AR scenes. They can practice listening, reading and speaking skills by clicking on animated 3D objects which display the word that corresponds to the chosen item. In addition, there is a mini-game to practice spelling, in which characters float in front of the camera's reality background and the user choose the correct letters to write the word. This prototype was built using the Unity and the Kudan AR plugin. However, it brings a different proposal by presenting the vocabulary through scenarios, which requires more processing and results in bigger response delays [8].

In 2019, they adapted the system by adding a module for exercises and resources for class management for teachers. Moreover, in the project, AR markers were added, which are a real base for rendering virtual 3D objects over them. This technique was employed in the prototype developed in this paper as well [9].

Another project that uses markers was implemented by Dalim et al. The project, called TeachAR, consists of a desktop application that aims to teach basic English words. In the first mode, the user practices the vocabulary by using several markers. The objects are displayed according to the chosen marker. In the second mode, the user holds a marker in front of the camera and say a shape and a color and then a 3D object appears according to the voice command. TeachAR was developed using the Unity, the ARToolkit plugin, the Microsoft Kinnect and the Microsoft Speech API. They reported problems with the recognition program and suggested Vuforia as a solution [10].

A different proposal of AR to teach English was presented by Lee et al. Their project consisted of a word-guessing multiplayer game, in which a user builds a 3D figure with block of different shapes and colors. Then, the other users try to guess what was built. All this dynamic is performed based on the AR technology. They used Unity and Vuforia to develop this application, which are the same tools employed in the scheme presented in this paper. However, its operation required a QRcode as a marker and a Facebook account login [11].

Another project on this branch was implemented by Limsukhawat et al. In this work, they developed a mobile game, called P-Whale, to teach English phonetics. Tools such as Unity 3D and Vuforia SDK were also used. P-Whale consists of four mini-games, of which three use markers cards from AR. All activities are directed to the study and identification of sounds [12].

III. Proposed Solution

The project's proposal was to build a collaborative game for English practice. The target public are mainly children whose native language is Portuguese from Brazil and the application's focus is the practice of vocabulary through associations with 3D virtual elements. For this, the system employs the AR technology.

The collaborative factor is the differential of the project, which offers an upload resource, so that users, such as parents, teachers or community collaborators, can expand the vocabulary existing in the game, sending the necessary files, as well as the Portuguese word and its translation into English.

A. System Architecture

For the implementation of the game the Unity development platform was used and to create the AR experience the Vuforia Engine was employed. Unity makes it possible to export to different platforms, has extensive documentation and there are several forums with content aimed at developing applications in this environment, which helped in the creation of this game. With Vuforia, developers can easily add AR functionality, allowing the recognition of images or objects, so that, after detection, interaction between virtual and real elements is possible.

In this project, the image recognition is done instead of objects because the chosen method is based on Image Targets, that is, the mechanism recognizes flat images to perform the projection of the virtual object. The Vuforia's system recognizes the image if it is in its database. The stored image has markings, added during the processing phase, which are the reference for distinguishing images from each other. This process can be seen in the Fig. 1.

Fig. 1. Vuforia's image recognition system.

In the Fig. 2, an AR system type and its flowchart are presented. The system has as components: cards that are image targets, a camera for card recognition, softwares responsible for data processing and all necessary logic and a screen for display of the 3D virtual object. This scheme was implemented in this project, therefore, in this work there are the same elements present in the image.

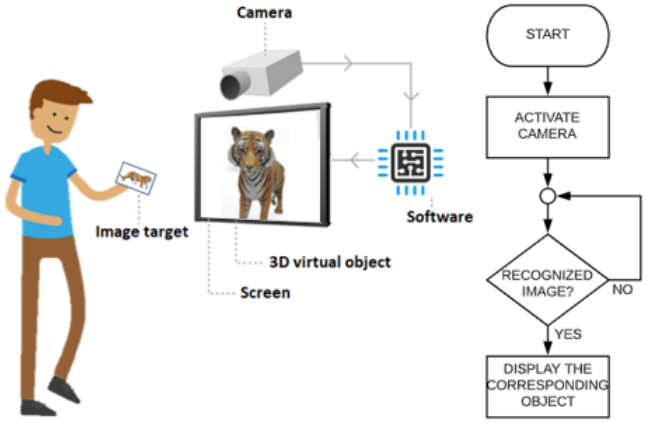

Fig. 2. Example of an AR system and its operation.

A basic AR system with Image Targets needs, furthermore to the base image, a three-dimensional model, which consists of 2 files, one that is the 3D shape and the other that corresponds to the texture, assigning colors and more reality for the modeling. In addition to these components, the built game also needs an audio file with the pronunciation of the word in English, so that the child learns not only the spelling and reading skills, but the speaking and listening skills too.

The upload resource was implemented in a mechanism for web display, using the HTML form. Fig. 3 shows the architecture of the upload system: the user must select the files; the base image is sent to the Vuforia's database, and this platform will perform the processing so that the image is recognized during the game; the rest of the elements are stored in the MongoDB Atlas' cloud database service, and are later retrieved by the algorithm implemented in Unity. Thus the game meets the proposed objective of being expandable and dynamic.

The default game already comes embedded with some files, but the custom ones must be uploaded to the cloud. In MongoDB, the GridFS mechanism was used to make it possible to store and retrieve audio, image and 3D model files.

B. The InglesAR Game

The Fig. 4 shows the game 1.0 version home screen with the options: start, upload and credits. The first option opens the category selection screen, as depicted in Fig. 5, to decide the topic to be studied. After the decision, the user can choose between play the practice mode or the challenge mode, as shown in Fig. 6.

Practice Mode is a kind of a casual game that can be used to reinforce the meaning of a word and its pronounce in English referring to a particular image, which the user must show for the camera. After recognition, the object is rendered as shown in the Fig. 7 and the corresponding audio is also played.

Challenge Mode, represented in the Fig. 8, is directed for verify vocabulary's learning, challenging the child to score high in this mode. In it will display a sequence of words and

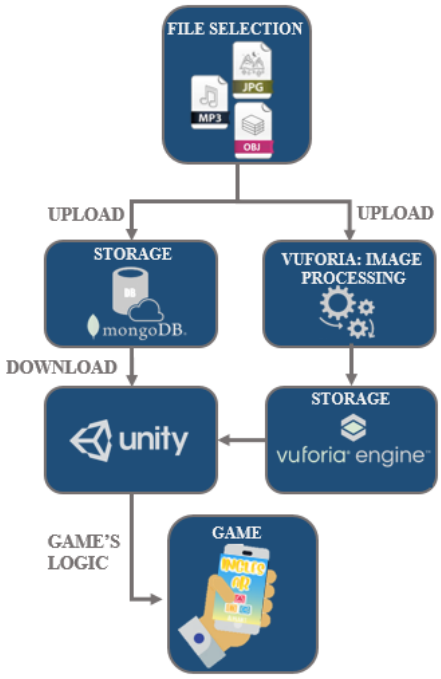

Fig. 3. Flowchart of the game's vocabulary expansion system.

Fig. 4. Game home screen.

Fig. 5. Category selection screen.

Fig. 6. Game mode selection screen.

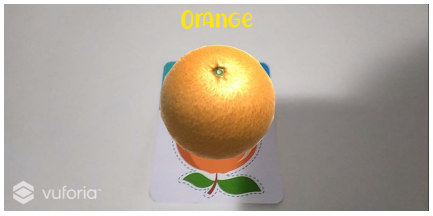

Fig. 7. Practice mode.

the child should show the correct Image Target. In addition to the scoring system, there is a timer, in order to make this game mode even more dynamic and stimulating.

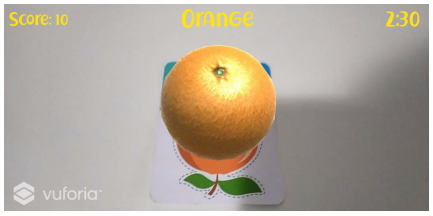

Fig. 8. Challenge mode.

The another two options presented on the game's main screen are upload and credits. The Upload option redirects the user to a web page, illustrated in Fig. 9. On this page, collaborators need to select a category for the word to be registered in the system, inform that word and its translation and send 4 files: base image, 3D model, texture and audio. Lastly, the credits option displays details about the game creators.

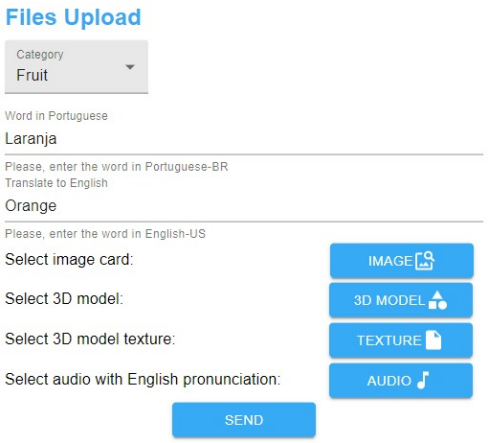

Fig. 9. Web page design.

IV. Conclusions

From the application of AR resources, this work aimed to present a collaborative game for practicing English directed mainly at children. It was verified through the researches that AR can be used as a playful tool capable of encouraging the study and facilitate learning.

However, in similar projects, the vocabulary offered was limited and, therefore, there was a need for a mechanism to expand it. The solution found was to make the game collaborative. The need to add this differential to the project brought new challenges, because for the game to be expandable it was necessary to have a file upload system, cloud storage and, finally, download the new files, updating the vocabulary offered in the application.

In the proposed work, the user can send the files without restrictions or instant verification of the content, with only the file format being validated. Content analysis needs to be done manually by the system's administrator. Therefore, a possible improvement that can be studied in future works, is the implementation of an intelligent mechanism, which makes it impossible to send inappropriate content. It is also important to test the proposed game in a group of english learners in order to verify its effectiveness.

Despite this, the game was able to achieve the intended objective, both in terms of gameplay and in the collaborative factor.

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