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Artificial Reality and Science Learning

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Abstract

The objective of this research is to focus on the use of recent technologies, such as Augmented Reality (AR). This contribution makes a synthetic point on the application of this technology which adds new frontiers in teaching and brings very concrete response elements in the learning and teaching context. All the indicators point to the potential of this New Information and Communication Technology (NICT), thanks to its qualities of adaptability, contextualization, immediacy of feedback, and learner motivation.
In this paper we try to answer the following questions:
Does this technology have a future in a teaching context?
Can it constitute a new device for the benefit of learning?
Through this research note, we propose to provide some answers, our article details research carried out on the use of AR in the context of scientific learning and teaching. Modeled objects (avatars) and their potentials offer a new range of possibilities and tools for teachers and students. Finally, considering AR as the interface between subject and machine provides students with powerful ways to learn and explore the world.

Key words and phrases: Augmented reality, learning, teaching, new information and communication technology, avatars.
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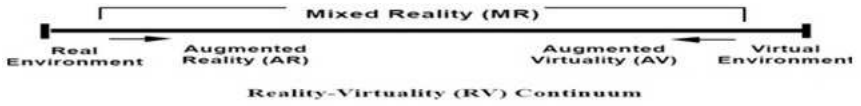

Figure 1: Continuum between the real and virtual world

1 Introduction

Augmented reality (AR) makes it possible to add modeled virtual elements (avatars) to the real world. The user is then immersed in a mixed environment where the virtual is superimposed on the real. Augmented reality must respect three fundamental rules: Combine the real and the virtual, be interactive in real time, and respect 3D consistency. Moreover, AR is a scientific and technical domain using computing and behavioral interfaces to simulate in a virtual environment the behavior of 3D entities 1]. The virtual environment is defined as a computer generated 3D simulation of a real or imaginary environment [2]. AR makes it possible to qualify a new form of human-machine interaction. This new NICT makes it possible to superimpose modeled objects on real objects from a daily environment in real time as shown in Figure 1. The purpose of AR is to allow learners and teachers to carry out experiments in a real environment and a virtual environment. Its use has increased and is diversified, particularly with the democratization of computers. Indeed, the presence of a camera on these devices makes them particularly suitable for capturing the real environment, and displaying it on the screen with other information. It can therefore constitute an environment conducive to learning since it stores and delivers information to the learner and increases his/her motivation.
In this article we support our reasoning on the engagement of students in science learning such as using the two stages:

a) Modeling of the object by 3D modeling software (Figure 2).
b) The application of AR (Figure 3).

Learning is an adaptive process where the learner and the didactic environment are in interaction and immersion. Subsequently, we can model real situations by authorizing successive decision-making by the learner. The methodology followed is based on didactic engineering making it possible to articulate an a priori analysis leading to the design of experienced classroom situations.

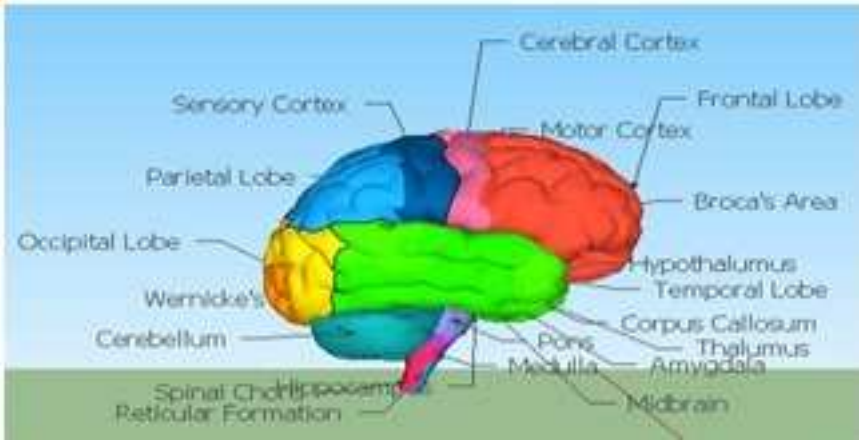

Figure 2: Modeling of the object by 3D software

Figure 3: Application of AR

2 Methodology

There are several collaborative augmented reality tools. We mention ARmedia that we applied in our research article in the school environment which allows learners to recognize emotions and perform actions based on understanding and regulating emotions (Figures 4 and 5).

2.1. Programming: Overall operation and loading an image

```
static void mainLoop(void)
{
static int    contF = 0;
ARUint8     *dataPtr;
ARMarkerInfo    *marker_info;
int     marker_num;
int     j, k;
/* grab a vide frame*/
if( (dataPtr = (ARUint8*)arVideoGetImage()) == NULL )
{
arUtilSleep(2);
return;
}
if( count == 0 ) arUtilTimerReset();
count++;
argDrawMode2D();
```

In this first exercise, learners discover characters in the real environment that show different emotions such as anger, sadness, joy, etc. Learners have at their disposal objects that represent actions to improve the emotions of characters and if a student manages to reach the objective, he/she can capture the character as in Pokémon Go. [3]. At the beginning of the exercise, the characters are randomly positioned in the virtual environment; the learners must therefore move to get closer to the avatars. As a second exercise we propose a calculation game using fruits that encourages learners to apply their knowledge of mathematics to do basic operations (addition, subtraction, multiplication and division) as in Figures 6, 7, 8, and 9 [4].

A hunting game in the form of an exercise that encourages learners to apply their knowledge of mathematics to capture fruit in their real environ-

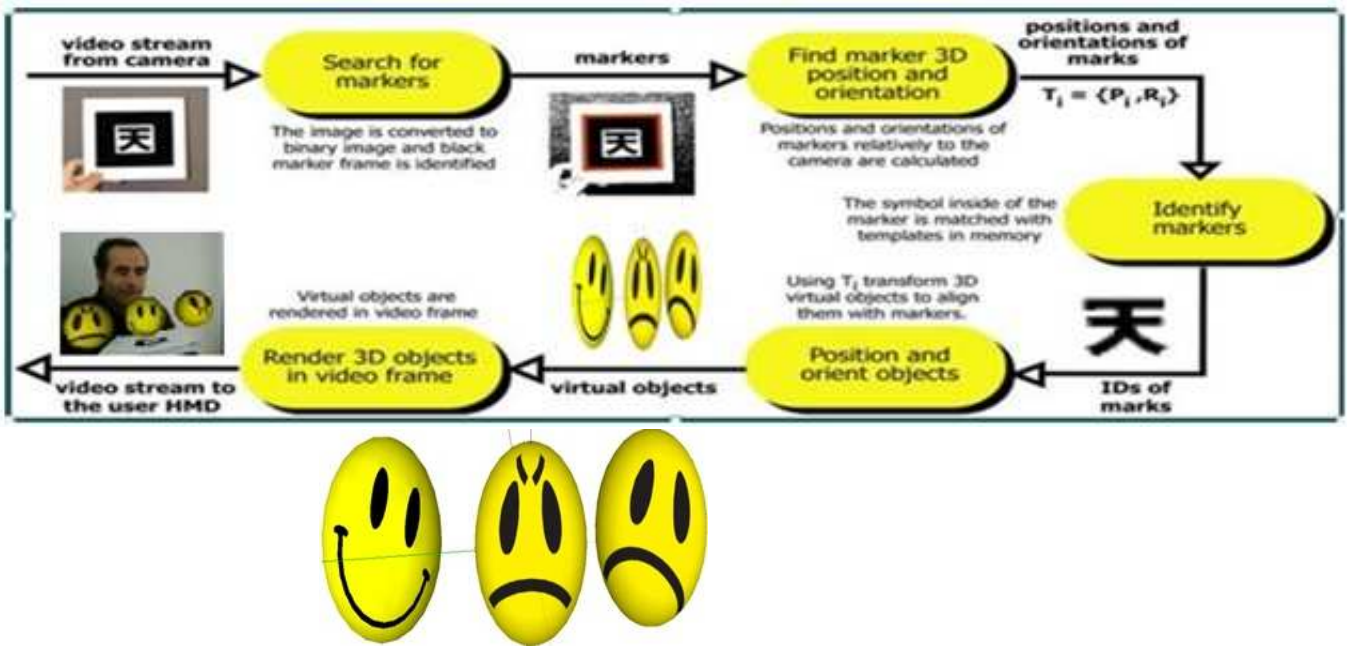

Figure 4: Part of the system 01 and 3D modeling

Figure 5: Application of AR

Figure 6: Learning addition

Figure 7: Learning subtraction

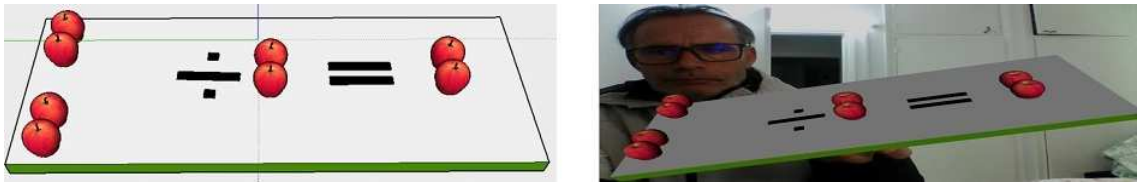

Figure 8: Learning division

Figure 9: Learning multiplication

ment. The learners are divided into teams working together to solve a series of exercises on the calculation, the winner team being the one managing all the results [5]. The game interface presents at the beginning the four types of exercise and the tasks that must be done to find the solution. Simple questions such as the identification of the results of the addition are asked. Students who give the correct answers move on to the AR session. They are given a clue to search for a specific real object in their real environment [6].

3 Results

Traditional methods of education are now a thing of the past. The introduction of technological revolutions in the classroom has made it possible to develop teaching practices and renew the way of teaching and learning [7]. Since its democratization, AR has been part of the range of digital-based teaching practices available to teachers. Applications of AR in a learning context offer new ways of teaching and learning [8]. Education teachers often encounter difficulties in exposing and presenting certain real or virtual interactive models. AR makes it possible to simultaneously visualize physical artifacts and the abstract notions associated with them. The superposition of virtual content on the daily environment makes AR exercises very easy to handle and use, especially for learners. By relying on the image of the real objects that surround them, learners can easily understand the notions provided by the device [9]. In addition, the manipulation of the modeled avatars would give a very strong feeling of presence which would facilitate the learner's memorization of data, since AR stores information and facilitates access to learning materials, and subsequently they minimize the use of paper supports.

4 Discussion

AR learning can develop critical thinking, but often the learners lack imagination especially when it comes to learning about heritage, neurology, biology, and neuroscience. Through applications, AR allows the teacher to present 3D visualizations of the different disciplines taught making the course more interesting and easier, thus arousing students' curiosity and interest [10]. Moreover, AR improves the motivation of learners due to the novelty of the mode of interaction and immersion in real time. These applications often used for learning are designed as games which makes them more attractive

to learners. With the enormous development of AR interfaces, the work environment has evolved. Learners have become more autonomous during the acquisition of knowledge, thus promoting the implementation of the educational approach. Learning has become easier, thanks to the interactivity brought by the use of applications of these technologies. Learning becomes more individualized and learners can proceed at their own pace [11].

5 Conclusion

This paper showed the interest shown in AR by researchers in information education. Our goal was to synthesize the contributions of AR for several innovative learning and teaching methods. We concluded that the use of AR in learning brings several advantages to pedagogical approaches. In various fields, AR has become a very interesting tool that allows learners to better themselves. In a school setting, the AR system is a real educational resource when transmitting information. In addition, AR has the power to engage learners in various interactive and immersive ways in real time and also allows providing each learner with a unique learning journey with very rich and diverse content. AR has also made learning faster and more efficient, thanks to the importance it has added to practice and the stimulation of visual memory. The future of AR in education looks promising as shown by the interest aroused in the various researches. New avenues can be explored. Indeed, during the design of an AR system for school use, it is necessary to reflect on the learning situation as well as the objectives of the training.

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