Application for Holographic Pyramids in Exhibition Spaces: An Expansion of the Teaching Model

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Research indicates that Augmented Reality can contribute to the challenges of communicating complex research findings in an accessible language to a broader audience. This research will use the methodology of Design Science Research divided by the following: (1) Characterization of current knowledge on the subject based on an integrative literature review in the Scopus and Web of Science scientific databases; (2) Requirements and architecture of applicable hardware and software.
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Introduction

Augmented reality (AR) is the overlap of virtual elements and reality. This technology got popular in 2016 with the game Pokémon GO, which brought light over the AR, especially for the grate masses. Even though the popularity of AR had achieved extraordinary numbers in 2016, its origin comes from long before. It was created in 1992 by the scientist Thomas P. Caudell to make an easier way of building the Boeing 747. However, the project to build a monitor to guide the installation of the Boeings' parts was not successful. Caudell's monitor did not work, but it does not cancel that he is the father of AR, a technology with much potential. The AR can be used in the making of cars, in surgeries, in education, translation, facial scanners, and many others.

In Brazil, the AR has already been used in museums, as in the National Historical Museum in Rio de Janeiro, which counts with a system of augmented reality. This system has the responsibility of giving museum visitants additional information about the pieces in the exhibition, especially the exhibition of the royal carriages and cars of the empire that has been the principal pieces involved in the system of AR. The museum faces some difficulties, knowing the AR system is available to visitants, the necessity of a good internet signal, due to it is an old building (XVII – XVIII century), and the internet signal is too weak inside the museum, and also the mobile data has some trouble working inside the building [1]. All those difficulties reduce the efficiency of the AR system and reduce the number of people that know and have access to the system and the knowledge that it holds.

The holograms have been used for many years, having started with simple techniques such as the Pepper ghost or Monga effect, which consists of light refraction to create optical illusions and advanced systems such as overhead projectors. Holograms are already widely used in the entertainment world. However, this image display technique has great potential for use in other areas, such as in the world of information display, where holograms can generate expansion of the way a subject is understood and exposed, expanding the absorption of the content and enabling the observation of details that were previously unnoticed. Holographic pyramids are a way more viable option for using holograms, even though it is not a hologram itself, the holographic pyramid has the same effect as a hologram projected to the eye of the same effect as a hologram projected to the eye of the observer, and this technique is very useful in exposing data and projects, and being a resource that is simpler to be handled and cheaper to build than the most advanced equipment for the projection of holograms.

The holographic pyramids belong inside of the world of the augmented reality (AR), which mixes

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the real world with the virtual world, bringing a whole new interaction between the virtual world and the user that is being exposed to this technology, AR brings an entire set of possibility to the exhibition world. Inside the AR, the holographic pyramids are a cheaper possibility to exhibit information and data, even thou the holographic pyramids are being more used in entertainment as a playful option to introduce the world of AR to children would be a great way to improve the teaching. For that matter, the use of holographic pyramids has much potential and has been already used in education because it can bring to the students a new way of seeing the subjects taught, which can get a novel experience and improve teaching as it is known, being able to teach subjects that were considered hard to understand more readily.

Material and Methods

The method in this paper follows the technique of literature research, going through similar papers and assimilating the main idea to create a new vision of augmented reality. The principal research has focused on the use of augmented reality in exhibition spaces such as museums, but also the capacity of this technology as a new tool in education, especially in the teaching of science in general. The holographic pyramids have great potential inside the classrooms, and this potential has been explored in multiple papers that bring on this subject, especially the use of holographic pyramids and AR in the school environment. The bibliographic research has focused on papers published from 2016 to 2021, the Google Scholar and the site SCIELO have been the principal sources of research for the articles.

Results and Discussion

After the literature review, the various applications of holographic pyramids, especially in education, were verified, and the holographic pyramids can expose subjects considered by most as difficult in a much more playful and palpable way, which makes the absorption of these subjects much easy. However, this technology in classrooms comes with several variables that can reduce the effectiveness of holographic pyramids use. Among these variables are the issue of building the pyramid, obtaining quadruple videos, and the Know-How to work with the pyramids and get the best of your performance.

The Holographic Pyramid Constructions

There are several models of holographic pyramids. The most common is the basic model composed of four sides with a transparent material (glass, acrylic, among others) and a device to project the images, transformed into holograms. Regarding the position of the projector device, the pyramids are divided into two groups, the inverted pyramids that have the projector device at the bottom and the non-inverted pyramids that have the projector device at the top. Pyramids can also vary in many sides and can have between three (Figure 1) and four sides (Figure 2), the 3-sided pyramid provides more space for projection, or the 4-sided model, which is the most common, in Figure 3 is possible to see a small comparison between the three-sided and the four-sided pyramid.

In addition to the projector positioning issue and the number of pyramid sides, refraction is also a crucial issue for AR. According to Shivani in his article “Holographic pyramids: conceptual errors and didactic potential”, when increasing the size of the monitor, which is responsible for projecting the images inside the pyramids, there is a simple “doubling” image. This duplication is due to the multiple reflection factor mentioned by Shivani. Depending on the angle of incidence, dimensions, and the type of material used in the pyramid built (acrylic, glass, polymers, among others). To ensure the stability of the structure by enlarging the size of the pyramid, it is necessary to build it using materials already mentioned. Therefore, we chose to use 4.0mm thick acrylic sheets, especially because it is lighter and offers less risk of accidents when compared to glass (Shivani, 2017).

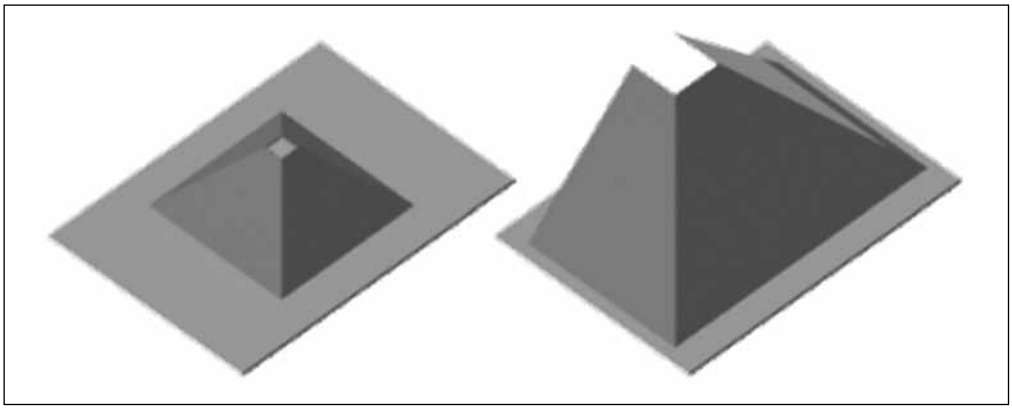
Figure 1. Three-sided holographic pyramid model with the overhead projector.

Source: Blupix.

Figure 2. Four-sided pyramid model with the projector on top.

Source: Four-season electronics.

Figure 3. Comparison of the area of the pyramids with 4 and 3 sides about the projection screen in the top view.



Source: Gabriel Anciuti [2].

According to the Shivani model, some measures are recommended, as follows: the use of 2mm thick acrylic, to reduce the internal reflection of the images, in addition to the Shivani scaling (2018) that has a trapezium with a dimension of 24 cm at the base, 14 cm from height and 4 cm at the top, these being the base measures, and the pyramid can be built at different scales from the multiplication or division of the measures already mentioned, in addition to the measures already mentioned, it is recommended that a triple layer of an automotive film be used, to thus decreasing the reflection rate, thus eliminating the appearance of double images.

Obtaining Quadruple Videos

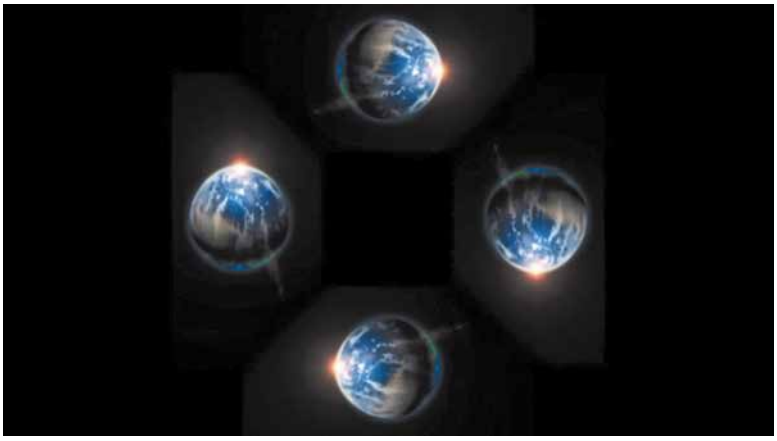
Another issue for holographic pyramids is the manufacture of quadruple video, the type of video necessary for the use of pyramids. It is necessary to manufacture a video in which the image you want to transform into a "hologram" is represented four times (Figure 4). Each image is positioned at one side of the video, all with the same distance from the middle that must remain free. This free medium is where the pyramid should be positioned. The video must be done through some computational method. The Sony Vega is an option because it is free, easy and intuitive handling, which would be recommended for people who are not so familiar with the area of computing and video editing. However, the pyramid user can make the video where he feels most comfortable as long as he uses the information above on how the images can be positioned.

Conclusion

Given the above, augmented reality has many possibilities within exhibition spaces, with even more potential within the scope of education, having the ability to make learning much more playful and efficient by bringing the idea of the third dimension to classrooms, thus creating the possibility of exemplifying subjects considered abstract more efficiently.

Thus, the use of holographic pyramids in classrooms brings, in addition to the possibility of more efficient teaching, difficulties that can be surpassed using the parameters already defined and the correct materials. With the writing of this article, it was possible to visualize the influence of augmented reality in everyday life and the influence of technology on education, showing that technological advances can be of great help in education since scientific advances and education are interconnected.

Figure 4. Quadruple video example for holographic pyramids.



Source: Trendy.

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