A Survey on Different Approaches to Augmented Reality inthe Educational Field

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***Abstract*—Technology in education can help students to learn actively and can motivate them, leading to an effective process of learning. In present days, students can tend to lack the interaction between the real and the virtual world.To solve the above problem and to facilitate passive learning, augmented reality plays an important role. Many educational institutions have adopted the use of AR technology over the traditional technology(e-learning) learning and traditional method of teaching such as chalk and whiteboard, the main reason is due to the fact thatAR provides students with a realistic experience making complex things look easier. With the use of AR technology, the students tend to lack misconceptions as the depth of understanding and the visualization are better when compared to the learning from the traditional method. The purpose of this paper is to understand how AR technology is used in educational fields.**

***Keywords*— Augmented Reality, Mixed Reality, Computer Graphics,Markerless AR**

I. INTRODUCTION

Augmented Reality(AR) is one of the emerging technologies that help in superimposing computer-generated virtual graphics and objects in real-time in the real environment. Augmented Reality is often considered to be an essential tool in visualizing abstract concepts due to its ability to 3D manipulations without the fear of facing harsh consequences of committing mistakes. This technology hence has seemed to be emerging in the domain of education. The affordance of AR in improving spatial ability has been explored by a fewresearchers for higher education students.

The affordance of AR in improving spatial ability has been explored by a few researchers for higher education students. The exploration of AR for understanding the spatial ability in manipulating 3D virtual data is often discussed. It is also evident that the students can be trained to acquire spatial skills in subjects like Geometry which can be applied in other domains.

II. MOTIVATION

The development of Augmented Reality (AR) technologies has led to new opportunities and challenges for the designers of e-learning systems. The importance of Augmented Reality is to enhance the students' motivation to learn. AR technology maytend to experience usability issues and technical problems, and some students may find this technology complicated. Thus it can be both beneficial and complex depending on the complexity.

III. LITERATURE SURVEY

Zhenliang Zhang et al. [1] proposed a framework called inverse augmented reality (IAR) which describes the scenario that a virtual agent living in the virtual world can observe both virtual objects and real objects. This is different from traditional augmented reality. Thetraditional virtual reality, mixed reality and augmented reality are all generated for humans, *i.eThey* are human-centered frameworks. On the contrary, the proposed inverse augmented reality is a virtual agent-centered framework, which represents and analyzes reality from a virtual agent's perspective. In traditional augmented reality, there are three key components, *i.e.*, the humans, the physical world, and the virtual contents added to the physical world. As a correspondence, the same structure applies to inverse augmented reality. Concretely, inverse augmented reality also contains three key components, *i.e.*, the virtual character, theprogrammable virtual world, and the physical contents added to the virtual world. They have utilized Microsoft HoloLens as the basic platform to demonstrate the concept of IAR. Both AR and IAR are implemented by Unity3D and the Vuforia software development kit.

Xiaodong Wei et al.[2] in his work has proposed a game-based guidance system and a time travel gamecalled MAGIC-EYES has been proposed withAugmented Reality technology. Six interactive modes are designed in the proposed system to guide tourists to visit the specified place. At the beginning phase of design, the information about the popularity of each scenic spot is obtained from the staff, Then a tourist route that is not popular is chosen. Altogether eight designated scenic spots in the tourist route are chosen. Physical objects such asplaques, stone tablets, and patterns of buildings are chosen to be the recognizable markers of a guidance system to identify whether a tourist has reached the designated location. MAGIC EYES also makes use of such sensors in a mobile phone as a camera, gyroscope, and global position system (GPS) to identify the images of recognizable objects, the viewing direction of tourists, and the geographical location information. The method of control experiment was adopted and the traditional guidance system uses the traditional audio, cartoon, and GPS to guide a tourist to reach the designated place and display the historical legend. A whole story of the game that includes six tasks, A tourist can arrive at every designated place under the guidance of the tasks and vintage map. The different interactive modes for each task is designed, which fuses six types of multimedia resource first in order to help itsuser learn the legend of the game, and then the hints of designated place are displayed. After identifying that a user has arrived at the designated place, MAGIC-EYES will continue to display the mission or puzzle of the task. If the user fulfills the mission, MAGIC-EYES will jump to the next task until the whole task of the game is completed.

Alexander Sosin et al.[3] has proposed a work that explores an architecture designed to allow both individual and corporate bodies to equally contribute to the construction of a sensor network, providing a platform in which the growth of the AR environment is in the hands of its users. A distributed blockchain-based model capable of storing tracking entity poses data. The model allows users to contribute tracking entities to the blockchain and to share this data through peer-to-peer connections. The concept of UT for AR encompasses a wide range of different areas and components, thus, a layered model for the development of WARP has been proposed in this paper, a total of 4 layers has been proposed.

- Context Layer: This layer defines the ground truths and foundations utilized by the rest of the layers. It defines a strict way of representing physical tracking entities in a structure suitable for use by the rest of the layers. It also provides mechanisms for easily modifying and extending the scope of the tracking area by adding or altering tracking entities and then propagating these changes to all users.

- Inference Layer: This layer reads input from the above layer to generate spatial relationship graphs (SRG) for the areas surrounding the user. Unlike scene graphs, SRGs represent relationships between real-world objects in addition to virtual objects.

- Device Layer: This layer should allow communication between adjacent layers and should act as a virtual interface for the querying of data from the Inference layer.

- Application Layer: It facilitates the incorporation of applications running on

WARP. To allow for the construction of a creative collaboration community, an API for this layer needs to be defined and made public to allow for the fostering and development of applications and experiences in AR.

Thammathip Piumsomboon et al.[4] has proposed a mobile Augmented Reality (AR) platform that uses a magnetic tracker and a depth sensor for games and interaction development that is typically only available on a desktop system. It was achieved using off-the-shelf hardware and efficient software that canbe easily assembled and executed. They have demonstrated four possible modalities based on hand input to provide a platform that game and interaction designers can use to explore new possibilities for gaming in AR. The platform provides the basic simulation process in four simplified steps, which are point cloud acquisition, transformation, reconstruction, and simulation. A point cloud is acquired from the depth camera using the OpenNI library. All points are converted from the depth camera coordinate system to the magnetic tracker's coordinate system. Finally, the points are triangulated to create a vertex array for mesh construction and then added to the simulated world. Any detected change in the controller or transmitter's position and orientation must not exceed a threshold, such that updates only happen when the controller and the transmitter are in a stable position and orientation.

The mesh is averaged with the existing mesh data to smooth the transition, which helps reduce mesh error due to unintended or rapid movement. If a real object is positioned directly in front of virtual content causing an occlusion, then the mesh behind the real object will not be updated.

Pratiti Sarkar et al. [5] has suggested a system that focuses on identifying the design strategies and considerations in the form of a framework that is required to design AR learning experiences for middle school students in a classroom scenario .

Based on the strategies and principles available in the literature and the user expectations gathered from thestudy, two Augmented Reality Learning Experience(ARLE)s are designed with two different interactions:

1. Drawing on a superimposed 3D object, and

2. Manipulation and interaction in 3D space bytouch

This helps in defining the effectiveness of the adopted strategy for designing the ARLE on the learning outcome of using the ARLE. With the help of the design strategies and principles suggested in the literature and the validation of the strategies applicable to designing our ARLEs for the classroom, a framework will be designed. This framework will help the designers and education researchers to design ARLEs for their context in the classroom environment.

Table 1. The drawbacks of the following approaches

Author and Year	Title	Remarks
Zhenliang Zhang, Dongdong Weng*, Haiyan Jiang, Yue Liu, Yongtian Wang	Inverse Augmented Reality: A Virtual Agent's Perspective	1. Physical construction of virtual objects in the physical world. 2. Specific design of virtual-to-physical bridges. 3. Intelligence and knowledge for the self-driven virtual world.
Xiaodong Wei, Dongdong Weng, Yue Liu, Yongtian Wang	A Tour Guiding System of Historical Relics Based on Augmented Reality	Creating the proper details and visualization of the places with not much data is challenging.
Alexander Sosin*, Yuta Itoh	WARP: Contributional Tracking Architecture towards a Worldwide Augmented Reality Platform	The technologies surrounding AR is becoming increasingly morecomplex and advanced in preparation for wide-scale commercialization . Thus the development of global ubiquitous tracking systems would attract attention.
Thammathip Piumsomboon, Adrian Clark, MarkBillinghurst	KITE: Platform for Mobile Augmented Reality Gaming and Interaction Using Magnetic Tracking and Depth Sensing	Need to improve on the algorithm for mesh reconstruction making it more accurate and stable
Pratiti Sarkar	Exploring Design Strategies for Augmented Reality Learning Experience in Classrooms	Experimental studies need to be conducted and validated iteratively. There are a few unexplored research approaches and technical learnings.

IV. CONCLUSION

From the survey of existing methodologies and the techniques used in the field of AR, it is clearly observable that the techniques and methodology have been effectively proven to be accurate, quick, deployable. While the simulation of the proposed system accurately shows the intention behind its development, there lacks any form of quantitative evaluation.

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