Art and Architecture Journal
Volume 5, Issue 1, 2024, P1 - 16
Print ISSN 2805 -2838
Online ISSN 2805 -2846

HOLOGRAM TECHNOLOGIES AS A NEW APPROACH IN ARCHITECTURAL EDUCATION PROCESS

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ABSTRACT
Utilization of technology and application in educational institutions provides advantages for both teaching and learning. The global pandemic has made it imperative for the educational system to find safe ways to meet the educational requirements of students. The results were able to automate implementation tasks, such as site building, construction and finishing materials. This paper aims to improve the teaching and learning methods; to providing resources and technologies, while simultaneously granting tools that assist via more challenging problems like learning control and lack of imagination. The relevance is to face and develop students by allowing them to optimize their resources, reduce costs, and improve service delivery; as a part of Smart Learning Sustainable Environment (SLSE) while preserving the Building Information Technology (BIM), and Hologram in Architecture (HA) to improve Smart Education Systems (SES). This paper provokes how hologram could be easily incorporated into the building process, giving lecturers the ability to explore design interactions in an immersive learning environment and make modifications throughout real time.

Keywords: Smart Education System (SES), Smart Learning Sustainable Environment (SLSE), Hologram in Architecture (HA), Smart Student (SS), Building Information Technology (BIM).

1 INTRODUCTION
Nowadays; researchers have been working on improving hologram technology and altering the intangible nature of light so that people can interact, feel, and occasionally even touch it. Hologram technology has grown in popularity recently. As imagination and reality merged, the architectural world grew progressively interactive.

This paper determinate the concept of smart education is missing, the tardiness of its introduction and adoption in architecture and construction, as well as the elucidation of the function of contemporary technologies and the degree of their influence on students. Subsequently this paper attempts to accomplish the primary objective, which is the integration of smart technologies into architectural academic education, identifying the tools required for accomplishing the above, investigating the processes and strategies for incorporating holography in architecture and construction processes, and emphasizing the significance of incorporating those applications into future academic processes development.

2 METHODOLGY

Research methods employed in this research vary considerably depending on the particular aspect of analytical approach, deductive and applied methods. The analytical approach in order to review the justifications for the need of new technologies in the architectural academic field, which led to the importance of holography as a futuristic smart technique in educational process; in order to settle the interaction between official site work and pre-graduated architects and students, it is necessary to turn to smart technical solutions. In particular, the use of information and communication technology in the field of developing education tools and services.

Following that; the deductive method discusses the concept of smart architectural education and its requirements and needs, ways to meet the official work challenges in the academic process using hologram technologies and the possibilities offered by educational organisations in order to achieve the concept of smart students. Finally, the applied method settled Singapore school of architecture as one of the most important smart universities all over the world. Thus, the importance and recommendations for the application of hologram technologies and solutions in the future educational process.

3 HOLOGRAM TECHNOLOGIES AND DEFINITIONS

In the above decades, architectural models have been an essential tool in the architectural learning process. Architectural firms can test spatial relationships, engage students and lecturers, and communicate their ideas through these physical representations. Thus; compared to more conventional teaching methods, hologram technologies allowed students to comprehend more, as hologram will demonstrate each detail of visual depth, identical to how a real object would display (1)

3.1 Hologram definition

The Greek word hologram; which means comprehensive vision, is derived from the word (gramma) which means letter and refers to the entire picture. The term is used to describe holographic imaging. When a collision between these light sources happens, this imaging is done. Waves and the subject of the photo, while the holographic device records the object's data and sends the required information to the imaging panel. The term "hologram" describes the three-dimensional recording of objects, the medium used to

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Volume 5, Issue 1, 2024, P1 - 16
Print ISSN 2805 -2838
Online ISSN 2805 -2846

record it, and the resultant product of the recording process, known as the holographic process (2)

Anything that reflects light in a unique way, such as a credit card hologram or the quality seal found on pricey product packaging, can be referred to as holography. Since digital holography does not require the use of digital devices nor glasses for viewing, it can be created using three-dimensional digital data instead of the real physical object needed for classical holography. When a hologram is reflection-based, the light source is on the same side as the people viewing it (3), as shown in the following figure 1:

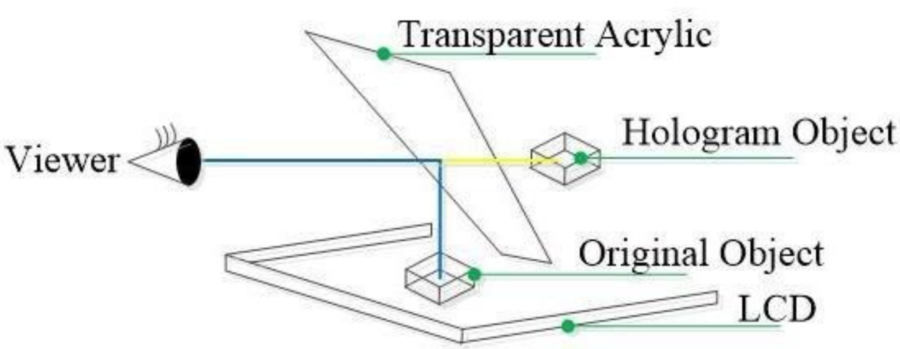

Figure 1 Reflection-Based (HRB)

3.2 Dimensions of holography in architecture

Developers struggle to find user-friendly applications because of the challenges in transmitting data and details related to the digital object, which is a part of the complex BIM based system; as shown in figure 2. Contributing factors to this challenge include the ongoing updates of proprietary software, the size of files and data to be processed in relation to hardware, the ongoing complexity of interoperability management, and the uniqueness of the digital model used in the current system (4).

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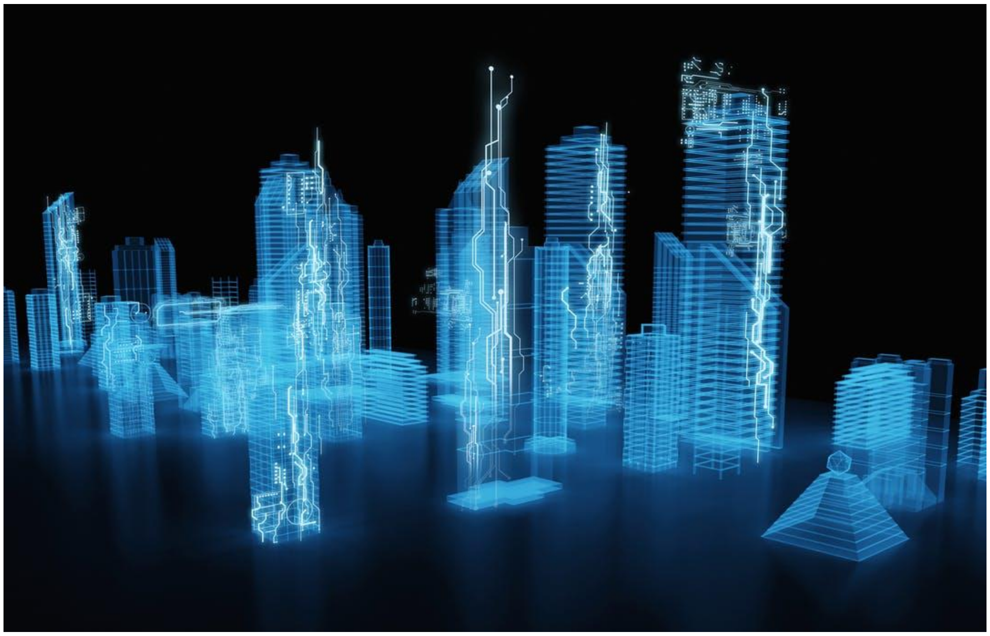

Figure 2: Futuristic holography in architecture

The technical concept for a hologram for architecture education is presented in an effort to create two inexpensive holograms with more sophisticated features. Proposing a conceptual scheme with the aim of maximizing potential and extending capacity, which could lead to a variety of uses outside the educational sector (5); as shown in the following figure 3, displaying 3d objects without students wearing glasses nor virtual tools:

Figure 3: Hologram for architecture education

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Realizing a sustainable life requires protecting and enhancing the global environment, which is why environmental education is so important. Understanding the complex interplay between the built environment and its physical, social, economic, and cultural components is one of the essential goals of environmental education. Another is equipping people with the information, attitudes, and practical skills needed to engage in responsible and efficient environmental quality management and problem-solving. Environmental education should incorporate the affective dimensions of behaviour, values, and commitment in order to raise students' awareness of the need to be more sensitive to the current natural conditions for a sustainable society. As a result, the teacher must have strategies for helping students comprehend and process values (6)

3.3 Set-up in construction holography:

It was necessary to precisely position these models within the actual physical surroundings of the building site in order to build directly from holographic models. This was accomplished by positioning the holographic model's origin at a randomly chosen spot next to the construction site, marked by a fiducial marker (7); as shown in the following figure 4:

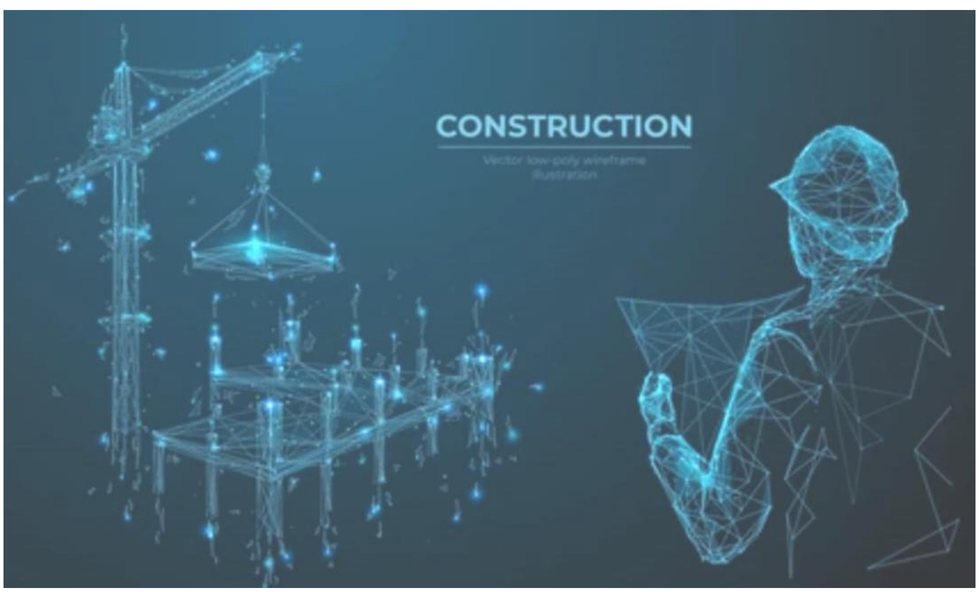

Figure 4: Holography in construction set-up

The majority of holographic instructions, as opposed to drawings, provide tasks with clear, scaled, and contextualized descriptions of their desired states. By giving both seasoned bricklayers and novices the same consistent reference to the ideal outcome for a particular task or series of tasks, errors were quickly found and recommendations for enhancement could be clearly discussed and decided upon. The team came up with and shared techniques for quickly aligning bricks to their holographic footprints, adjusting for level, and negotiating between holographic models and the physical surroundings. These logical methods for adhering to holographic instructions maximized building duration and accuracy while staying within allowable tolerances (7).

Thus, the holographic explores the potential of implementing information on objects throughout the model, ready for users to semantically enrich it, through an interactive visualization mode. The entire scripting process is now available to the general public. The organization utilize an infrared tracking system to determine their position and orientation in the space hosted by the holograms in order to control the interaction with the specially designed objects. Thus, the study concentrated on the potential for reading the data automatically in addition to the geometry. Utilizing the platform to explore data, pictures, and detail elements in an immersive environment, writing scripts, and utilizing educational tools (8).

4 NATIONAL UNIVERSITY OF SINGAPORE (NUS) AS A LEADING UNIVERSITY IN HOLOGRAPHY

Nowadays, the recent global scenario led to in an unusual and troublesome situation across several domains. The quick transition from in-person to remote collaboration has necessitated not only a quick and broad adoption of digital technology but also a shift in communication styles and methods. Teachers in the field of education have had to interact in novel settings; one of the biggest challenges has been combining in-person and online instruction. Taking the aforementioned into consideration, this work suggests a hologram-based system that enables remote students to be easily included in the classroom (9).

4.1 (NUS) college of design and engineering digital holography solutions:

The aim of the university is to promote engineering and design explorations, applications, and professions by merging NUS's world-class faculty of engineering and school of design and Environment. While computed assemblies can be filling the gap from idea to construction with uses varying from big buildings to tiny toys. Assemblies, a technique widely used in architecture and construction, allow the creation of complex structures by joining components of simpler shapes. Holograms are being used more often to complete assembly tasks, including on construction sites, as a result of automation advancements. Nonetheless, creating intricate assemblies is a difficult intellectual task. Users' creativity

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is severely limited by the amount of low-level details that must be specified in current design software (10).

Thus; it is possible to extend the reprogrammable meta-surface hologram to display multiple digital bits for amplitude and phase modulations, resulting in more adaptable and rewritable devices. The design of AI-powered sensing systems, where the measurement modes required by machine learning techniques can be generated by intelligent meta-surface on the physical level, is therefore an immediate and interesting application of such a hologram (11), as shown in the following figure 5:

Figure 5: Singapore’s leadership in Holography.

4.2 Singapore NUS Centre for 5G digital building holography:

While computed assemblies can filling the gap from idea to construction with uses varying from big buildings to tiny toys. Assemblies, a technique widely used in architecture and construction, with Singapore striving to provide 5G coverage across the country by 2025, the centre for 5G digital building holography hopes to play a significant part in the country's digital research transformation. Its specific goals include becoming a premier hub for digital building technology through the application of best practices, wide-ranging education, and high-impact research. It aims to revolutionize how people plan, create, and oversee Singapore's built environment by utilizing holograms, cloud-based digital twins, and 5G connectivity for smart techniques and built environment industry applications (12); as shown in the following figure 6:

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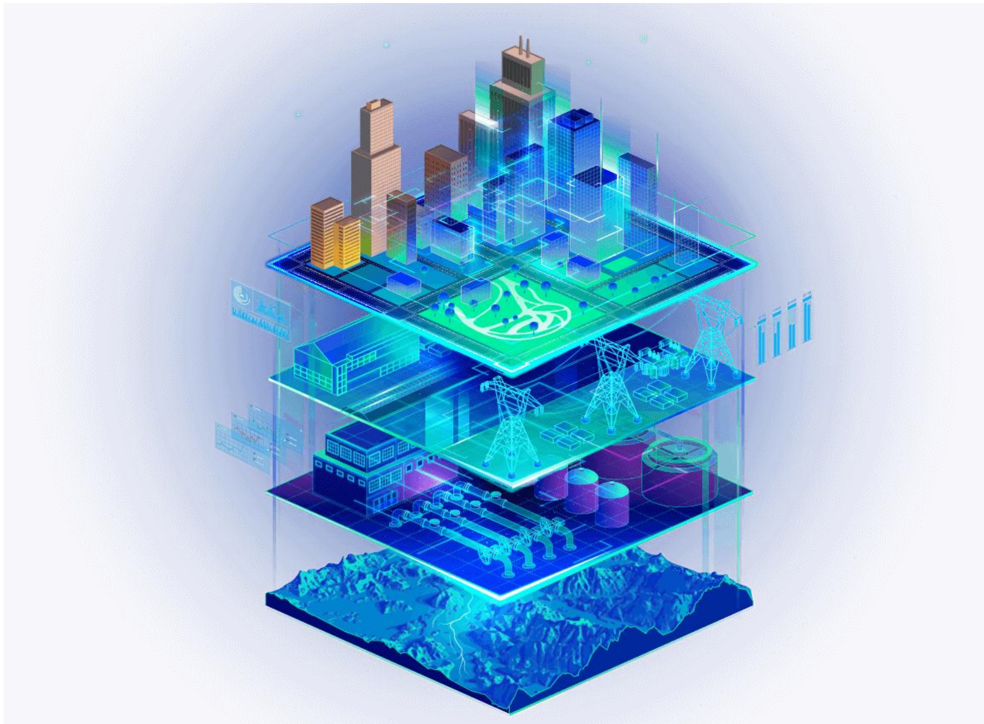

Figure 6: Singapore digital twin holography of the natural and built environment.

A digital depiction of the real world, complete with tangible items, interactions, relationships, and behaviours, is called a digital twin. GIS integrates a variety of digital models in a unique way and produces digital twins of the built and natural environments. Through the use of geospatial technology, disparate data sources and systems are connected to produce a single view that is accessible for the duration of a project. GIS improves data collection and integration, permits more sophisticated analysis and automation of future projections, improves real-time visualization, and facilitates information sharing and teamwork. Universities are using holographic digital twins to modernize data collection and visualization, network integration, and information analysis (13).

5 HOLOGRAM NURTURING DIGITAL WORKFORCE FOR THE FUTURE EDUCATIONAL CONSTRUCTION

Nowadays, large-scale automation and integration are driving the evolution of construction machinery, which is making the machines more complex in their designs and more sophisticated. Construction equipment will face significant challenges from labour costs and time. One potential solution is the use of mixed reality technology in educational progress. Remote collaborative design cases illustrate the efficacy of this approach (14)

5.1 Future construction holographic learning:

Preparing the optical components for the attendance student presents a challenge when teaching optical system construction. Nonetheless, mastering the construction of optical systems requires a great deal of hands-on learning. Using a low-cost learning system that offers opportunities for optical experiments facilitates learners' comprehension. Thus, in order to construct an optical setup using augmented reality, we suggest a new educational program. Thus; a digital twin bridge construction scene can be visualized more effectively and intuitively with the use of holographic projection technology. However, holographic visualization a static display is typically implemented through pre-rendering techniques in the research that is currently available (15).

Based on previous; It is challenging to prepare the optical components for the attendance student when teaching optical system construction. To become an expert in the construction of optical systems, however, practical learning is crucial. It makes using a low-cost learning system that offers opportunities for optical experiments easier for learners. As a result, we suggest a new educational program for building optical setups using augmented reality (16).

Thus; the holographic technology utilized in this study using a game engine and a Revit add-in. The add-in makes it simple to import data into the game engine from a Revit building information model. Furthermore, the developed hologram enables voice commands and hand gestures for user interaction. An experimental study was carried out on the game and the add-on to assess their usability and efficacy. The outcomes demonstrated that compared to conventional techniques for exporting building models from modelling platforms into a gaming environment, the developed add-in is more user-friendly and efficient. Additionally, the interactive hologram improved human-to-human communication among several users. Subsequent investigations will centre on enhancing the software and examining the application of the holographic experience in construction sites (17); as shown in the following figure 7:

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Figure 7: Holographic construction innovations

5.2 Simulated holography construction progress learning:

Furthermore, the management of the construction process can be significantly improved on a number of levels by utilizing real-size holograms. The holographic display on the job site can be arranged by planners to align with the construction schedule at the level of construction planning. As a result, this sequential holographic display follows the order of the schedule can be utilized to oversee the associated workflows and manage resources on location. When it comes to monitoring the project's advancement, managers can do so quickly by contrasting the completed work with the projected holograms.

For example, when a column is filled, a notification can be sent automatically indicating that this particular task is now complete. However, the quality of executed works can be improved by the use of to-scale holographic projections as shown in the following figure 8. Therefore, managers can utilize specialized sensors and applications to guarantee that installed elements precisely fit into their intended positions at the level of quality control and building alignment. On the other hand; real-size holograms are a valuable tool for teachers and students to share design intents during the design phase of construction projects (18).

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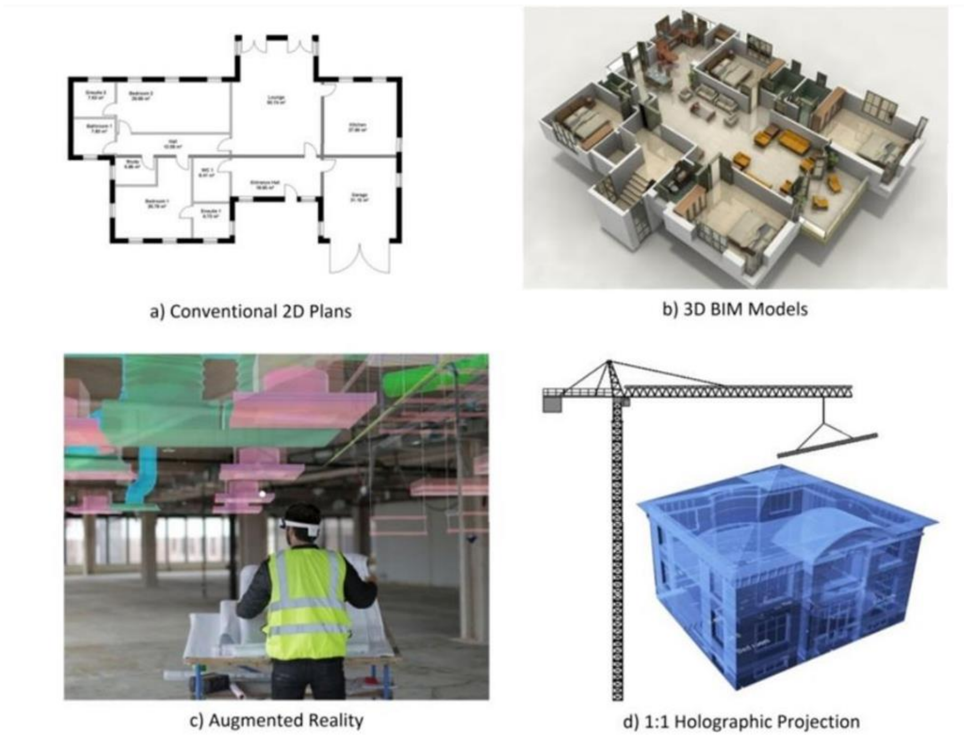

Figure 8: Progress of Information Display Technologies and Future Use of Holograms

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6 HOLOGRAM UBIQUITOUS CONNECTIVITY FUTURE LEARNING

Nowadays, hologram technology which creates a three-dimensional (3D) image may in the future aid in education. Holographic images produced by the 360° holographic display are viewable from any angle. A hologram will have every visual cue for depth that an actual object would have. Students benefit from models' true size in learning. Realistic reproductions inspire students. Holograms offer an additional method of instruction (20).

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6.1 System architecture and construction learning hologram scenarios:

There are three scenarios of holograms; which can improve the futuristic learning process and system in architecture and construction; as following:

1- The hologram of transmission

It is possible to see the characteristic transmission hologram using laser light, usually the same type that was used to record the image. This lamp is the image and hologram are focused from behind schedule and are projected onto the observer's side. The virtual image has the potential to be deep and crisp. For instance, a typical room with people could be seen through a tiny hologram (21).

2- The hologram of reflection

The replication hologram, which maintains an apparent three-dimensional image close to the surface is the most widely recognized type of hologram exhibiting in art galleries. The hologram remains illuminated in a precise location and distance, with a silver optimistic light spot that is anticipated to be seen by the viewer. Consequently, the hologram's copy of light made up the image (22).

3- The hybrid hologram

A hybrid hologram is a type of hologram that combines reflection and transmission holograms. A hybrid hologram is identified as computer-generated holograms, multichannel holograms, embossed holograms, integral holograms, and holographic interferometry. For instance, embossed holograms are utilized in applications requiring authenticity, like credit cards or passports. Optical elements are created by computer-generated holograms and are generally used to control laser light during scanning (23).

6.2 Hologram revolutionize the future educational process:

In the age of hybrid learning, where teachers and students might not always be in the same physical space in the classroom, holograms can improve education in a variety of ways. While holograms have numerous of advantages; holographic educational materials can enhance student engagement and enjoyment by enabling them to interact with content and examine it from various angles, as it can facilitate improved communication by mimicking in-person interactions between teachers and students. Experts or teachers located elsewhere can project lectures, presentations, or demonstrations, either live or recorded, using holograms. Additionally, students can work together with peers from other places or cultures by using holograms (24); as shown in the following figure 9:

Figure 9: Holographic future learning.

Therefore, holograms are a cutting-edge technology that have the potential to completely transform education. They can support students' ability to see abstract ideas, comprehend difficult material better, become more involved in their education, interact with peers and teachers more successfully, and explore new avenues for creativity. Though holograms have drawn a lot of interest in a variety of domains, the educational sector has not yet fully embraced them. Holograms present a plethora of chances to improve student and teacher experiences and learning outcomes. Thus, more instances of how holograms alter education as technology develops in the field of architecture and construction toward achieving the smart learning sustainable environment (SLSE); in order to enable students to maximize their resources, cut expenses, and enhance service delivery (25).

7 CONCLUSIONS:

While the growing adoption of recognizing technologies in architecture has made it necessary for construction engineering graduates to have the know-how to implement the technologies. Thus; applying of various hologram technical solutions to accomplish feasible holographic set-up in construction over a network in the future, both hologram data loading and launching platforms are constructed in order to meet the capacity requirement. In addition to creating high-based network technologies; the requirement also needs to be decreased. Two methods that use 3D object data transmission and hologram data compression in the field of architectural education. Therefore; this paper presents a frame-work of technical solutions in this field. Similarly, towards the above, holograms offer opportunities for improving missing senses for users who are hearing or visually impaired. These users can be easily assisted through voice, visual cues, and hepatic students.

Through the advancement of immersive experiential learning discourses that were previously limited by technology, this paper adds to the accumulation of knowledge. It provides a fresh direction for scholars and industry professionals to explore the potential of holography in the context of workforce development in the future. The main concept behind holograms is to augment people's abilities and mindsets to see and feel more in the real world. Thus, this paper suggests that future generations of researchers seeking to understand holography in architecture and construction during the educational process will find assistance and guidance from this study.

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Art and Architecture Journal
Volume 5, Issue 1, 2024, P1 - 16
Print ISSN 2805 -2838
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