Comparison of Holoportation Techniques for Today's applications

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Abstract:
Holoportation is a technique that is used to move objects from one place to another without touching them. Using this technique, every 2D image is converted into a 3D image, so objects should look like real ones. Many different devices are currently used to send images from the source to the destination. All techniques should be 2D image representation techniques. Adding a dimension to an object increases its realism. In the human brain, object reorganization is based on direction. A human sees an object with both eyes, though the 180-degree angle means that each eye sees the object at 135 by 135. So 90 degrees is common for both eyes and also common for left-right and top-bottom directions. One eye will cover 45 degrees in both directions (top down and bottom up). Object reality depends on object clarity. Clarity also depends on the direction. Our research depends on manipulating input data to add new directions and change a 2D view into a 3D view.

Keywords: Holoportation Technique, Eye Visualization, 2D to 3D, Virtual Reality, 3D Visualization, Human Holoportation.
DOINumber:10.48047/nq.2022.20.22.NQ10270 **NeuroQuantology2022;20(22):2775-2785**

1. Introduction

Holoportation is a technique for moving objects virtually without the need for physical transportation. Virtual movement is done with the help of light and direction. From time to time, many researchers are working in this field, but the challenge is that 3D image transfer from source to destination in real time is difficult. The eye angle is very important in the 3D view of an image. We added a virtual camera on 135 degrees, which means left, right, top, and bottom will be 90 and 45 degrees, just like human eyes. One of the most important aspects of adding third direction is the use of a virtual camera. The idea behind this project is to make a virtual 2D image look like a real one. This technology is very useful for those who are away from each other. They can meet and connect with other people virtually. We review six techniques and propose a new one in this paper. The eye is a wonderful part of the human body. Only with human eyes can a 3D image be created. Using supervised learning, it makes a product similar to human eyes. The process of creating an image is similar to the process of creating the proposed product. All of this technology is used to capture real-time images that appear to be real. We must assume that we will create an artificial system similar to the human eye that will convert and display every object image in 3D so that people will recognize it as a real one. We are trying to make a system similar to Rail One by using supervised learning. Because the human eye

system sends messages to the brain, whether 2D or 3D, the supervisor is the entire human eye system. Following that, the brain determines what type of object is being displayed for further processing

2. Literature Review

This study investigates how to minimize the problem of outdoor cylinder floating holograms in order to embody realistic content that can be installed in outdoor space. This paper suggests minimizing the diffracted reflection of light using a polarizing filter. A polarizing filter or polarizing lens is often placed in front of the camera lens in photography in order to darken skies, manage reflections, or suppress glare from the surface of lakes. Since a linear polarizer can be used to change the balance of the light in the photograph, Performances: The design for this hologram is mainly used for miniaturizing the view of hologram contents even in a narrow space. For the design of the cylinder, the fan is installed to minimize the problem of heat and humidity. [1]

Through the incorporation of 3D holographic LED fan displays during the development of experimental classes, it can be established that teachers can easily manipulate the resource. In this paper, a techno-pedagogical resource, a 3D holographic LED fan, is used for teaching purposes. For class development, this application will significantly encourage students' participation during the class's development. This technique is new for the teaching-learning process, and it is attractive from the student's point of view. This technology is used to facilitate the learner's understanding and learning of complex problems, allowing them to better understand real-world problems. [2]

This technology demonstrated many different interactive scenarios for one-to-one communication and one-to-many communication, both for real-time interaction. This technology is also used to record and playback memories for one-to-one communication and one-to-many communication, both for real-time interaction. This technology is also used to record and playback memories. The issue is that this technology is only used when data is stored in memory for an extended period of time. This paper presents a Holoportation full-3D end-to-end system for high-quality real-time transmission and rendering of people, spaces, and objects. This is based on mixed reality displays to allow users to see, hear, and interact in 3D with remote colleagues. [3]

With each camera rotation, by considering the reflection direction at the DDHOE, hologram data without any distortion caused by the DDHOE could be generated. This technology shows the reconstruction of 3D scenes and objects and the hologram data on the holographic projector. This paper is based on polygonal light sources based on the inverse distortion function of a DDHOE before the propagation calculation from the light sources to the hologram plane. [4]

This paper is based on mobile display through LBO projector models using computer-generated holography. The image will be visualised in a 3D model. Video frames will be viewed by the peaks and depths of each holographic image, which is used for image projection. [5]

A female dancer is perceived to be spinning clockwise or anti-clockwise by different observers; an immaterial screen is created by a cloud from a fog machine rising up in the air. As the image is cast on a column of fog rather than a flat screen, the light rays are scattered at different depth positions in the fog. This paper presents a fog projection installation, an illusion published online a decade ago. This gives rise to image thickness and depth, which create a virtual 3D effect. [6]

3. MATHEMATICAL AND COMPUTATIONAL CONCEPTS AND PROCEDURE

A. Computer-generated hologram: The technology of digitally generating holographic interference patterns is known as computer-generated holography (CGH). This is the subsequent illumination by a coherent light source. The advantage of computer-generated holograms is that objects that one wants to show do not have to possess any physical reality at all; in other words, it is a completely synthetic hologram generation technique.

B. EYE ANGLE: Each eye in the human body sees 135 degrees. The human eye sees objects with both eyes, though the 180-degree angle means that each eye sees an object 135 by 135.So 90 degrees

is common for both eyes and common for left right and top-bottom directions. One eye will cover 45 degrees in both directions (top down and bottom up).Object reality depends on object clarity. Clarity is also a feature of direction. Our research depends on manipulating input data to add new directions and change a 2D view into a 3D view.

C. 2D IMAGE: A 2D image is the computer-based generation of digital graphics images. It's mostly made up of two-dimensional models.2D computer graphics are mainly used in applications that were originally developed using traditional printing and drawing technologies, such as typography, cartography, technical drawing, advertising, etc.

D. 3D: 3D adding one more direction to 2D is called 3D, which means three-dimensional, i.e., something that has width, height, and depth (length). Our physical environment is three-dimensional, and we move around in three dimensions every day. Our brain is take input from retina in each eye forms a two-dimensional image of our surroundings, and our brain processes these two images into a 3D visual experience.

E. HOLOGRAM: A hologram is a 3D image, and a virtual display of a three-dimensional image system is also called virtual reality. This image system is easy for the human brain to understand in the case of complexity.

F. Rendering: Rendering is the process involved in the generation of a two- or three-dimensional image from a model by means of application programs. Rendering is used in animated movies, video game design, architecture, and simulator design for the visualization of images.

G. **REAL-TIME TRANSMISSION:** Real-time communications (RTC) is any mode of telecommunication in which all users can exchange information instantly or with negligible latency or transmission delays. In this context, the term "real-time" is synonymous with "live" or a real word.

H. 2D TO 3D: Adding another axis and converting the image to 3DA 3D image appears more realistic. Change the camera angle and capture the image in 3D format. In another way, we can say that we add one more direction so that the view will change and it will look like a 3D image, like a human eye.

4. TECHNOLOGIES WORKING IN REALITY:

1. **Pyramid Hologram:** This pyramid is made of four mirror or half-reflective glasses. The normal screen is installed on the base of the product at an angle. This technique is based on the reflection hologram type. It consists of pyramid glasses installed on the top of the screen that make a pyramid-type shape. Join all of the mirrors at the top of the screen. This pyramid mirror is reflected on a screen and shows 3D objects. A hologram is displayed as a 3D object that is floating in the air in front of the human eye. [12].

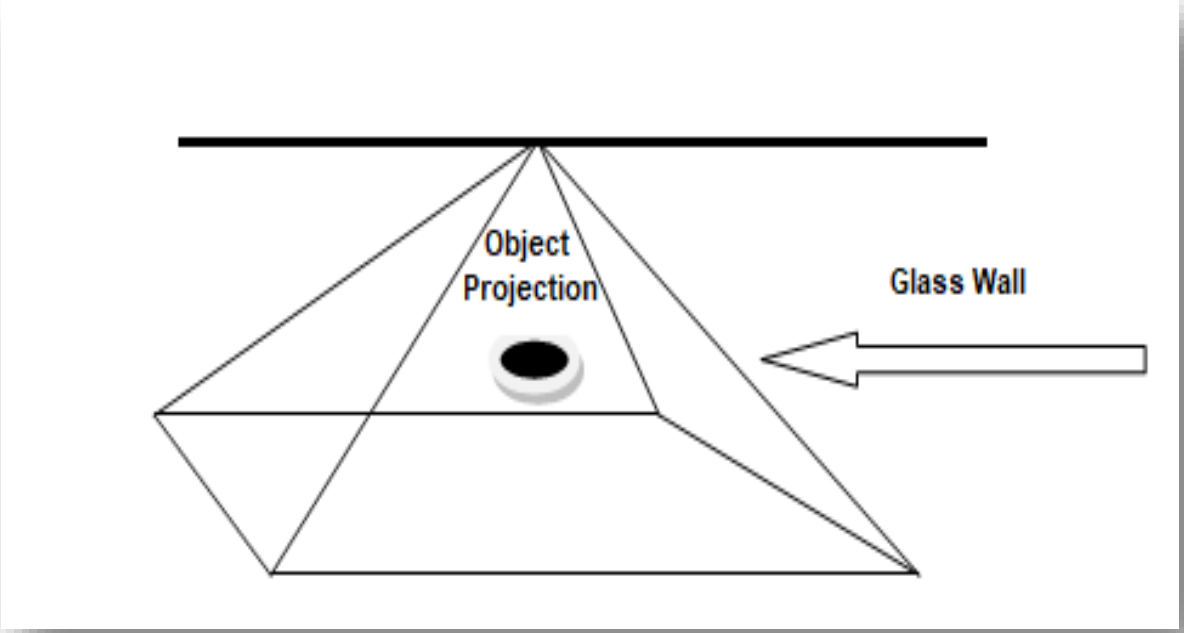

Fig1. PYRAMID HOLOGRAM

2. **Microsoft Holoporation technique:** For full 360° capture of the scene, deploy N = 8 camera pods placed on the periphery of the room, pointing inwards to capture a unique viewpoint of the subject scene. Holoportation allows high-quality 3D models of people to be reconstructed, compressed, and transmitted anywhere in the world in real time. This technique is used for face-to-face communication. . This new mobile holographic transmission system increases the potential applications of real-time 3D capture and transmission. The combination of augmented and virtual reality is called holoportation. In this technique, a camera is used to capture objects using depth. 3D modems transmit real-time images to a remote user using this technique. In this technique, there are 8 pods for capturing real time images and producing them through a remote user. This technique captures the object's depth. These techniques capture multiple views and send them to remote users at the same time.

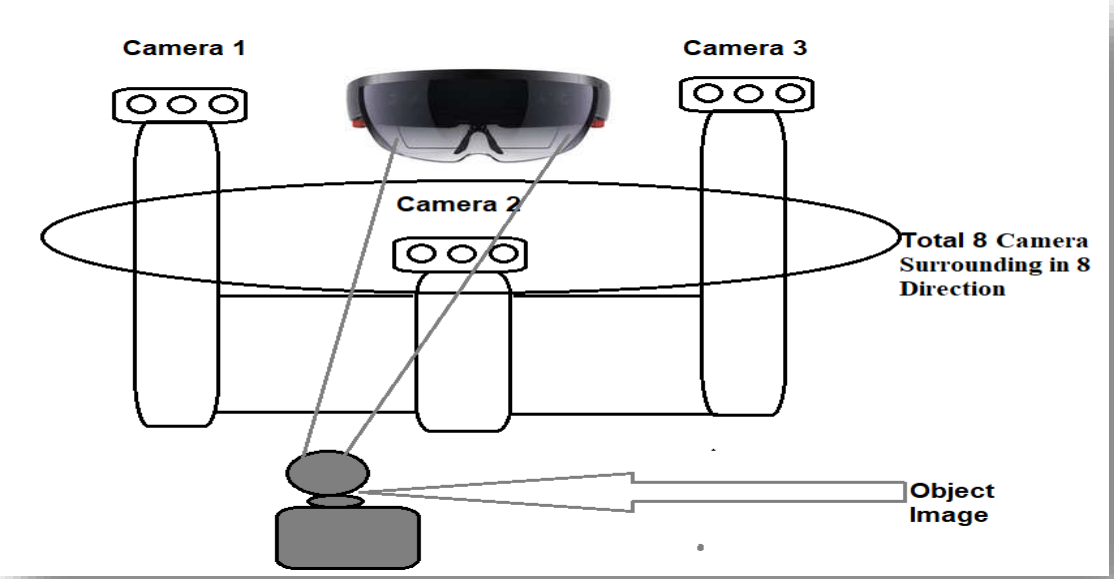

Fig2. MICROSOFT HOLOPROTATION TECHNIQUE

Holoportation is a 3D image capture technology working on high-quality 3D models of people to be reconstructed image, compressed image, and transmitted anywhere. When combined with mixed reality displays such as HoloLens, this technology allows users to see, hear, and interact in 3D with remote participants as if they were actually present in the same physical space. Face-to-face communication is possible through this technology. The only way to make holoportation truly mobile is to take this technology outside of the studio and into a car. This method reduced bandwidth requirements by 97% while maintaining image quality [13].

3. **Portl :** This technology is based on 4K volumetric resolution, and the person being beamed in can hear, see, and completely interact with another person from anywhere, no matter what the geographical distance. A high-resolution flat-screen monitor is used for visualisation in a rectangular box. Here we are using a white backdrop setup along with a camera and lighting. Just like a mobile device, this device has an audience-facing camera that's embedded in every single PORTL that sees the audience. The output of each PORTL is completely self-contained, making it the only hologram projection device. [14].

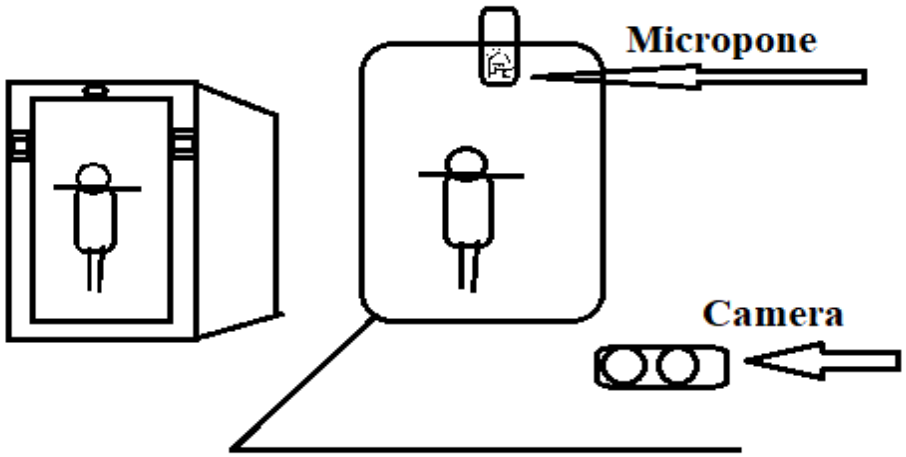

Fig3. PORTL

4. **Fog:** This research focuses on 3D reconstruction covering a 25*25*25 mm volume in full color with a viewing angle of 15 by employing horizontal parallax. Spatial light modulators (SLMs) are used to expand the display's 3D view. Photosensitive materials are used to overcome the resolution limitation of current SLM. Controllable light is used to penetrate a fog. This technique is based on illusion. SBP (space-bandwidth products) created a visual angle and display size. A convex lens is used to increase the display size and visual angle while also focusing the reconstructed light on a specific observation area. Some general optical elements are used because they have a diameter large enough to cover the whole display The projected image was then reflected to the assumed observation point by a screen function that is a replica of a large concave mirror [15]

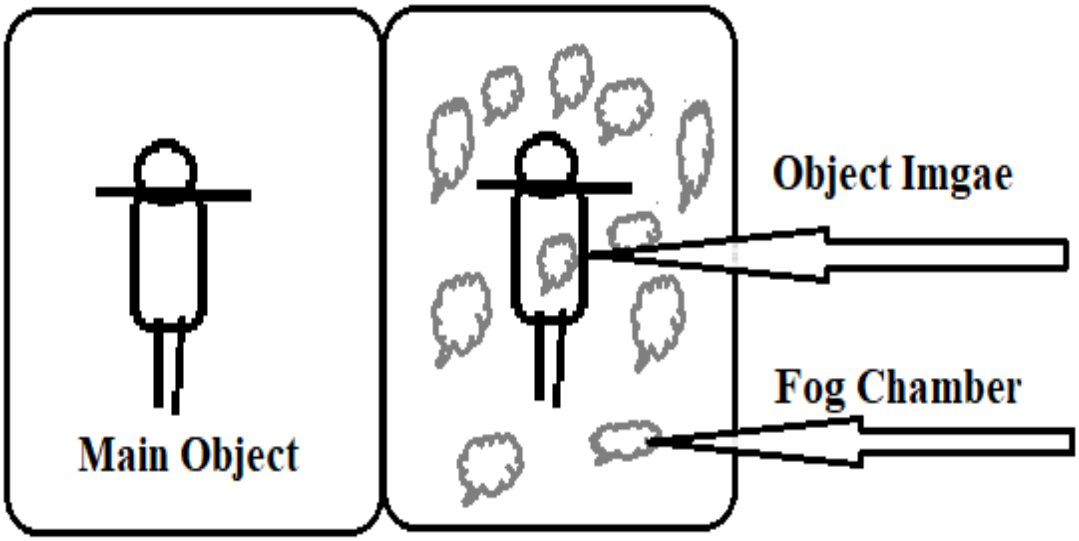

Fig4. FOG SCREEN

5. **LED Fan:** The methodology used in holographic projection is 3D holographic LED-fan display. This technology is used for smart learning environments. The number of LED pieces that allow the projected images to be viewed and their resolution through LED lights that are rotated the angle of rotation, as well as the fact that it supports multiple image formats, should be mentioned. The output looks like a real image. [16].

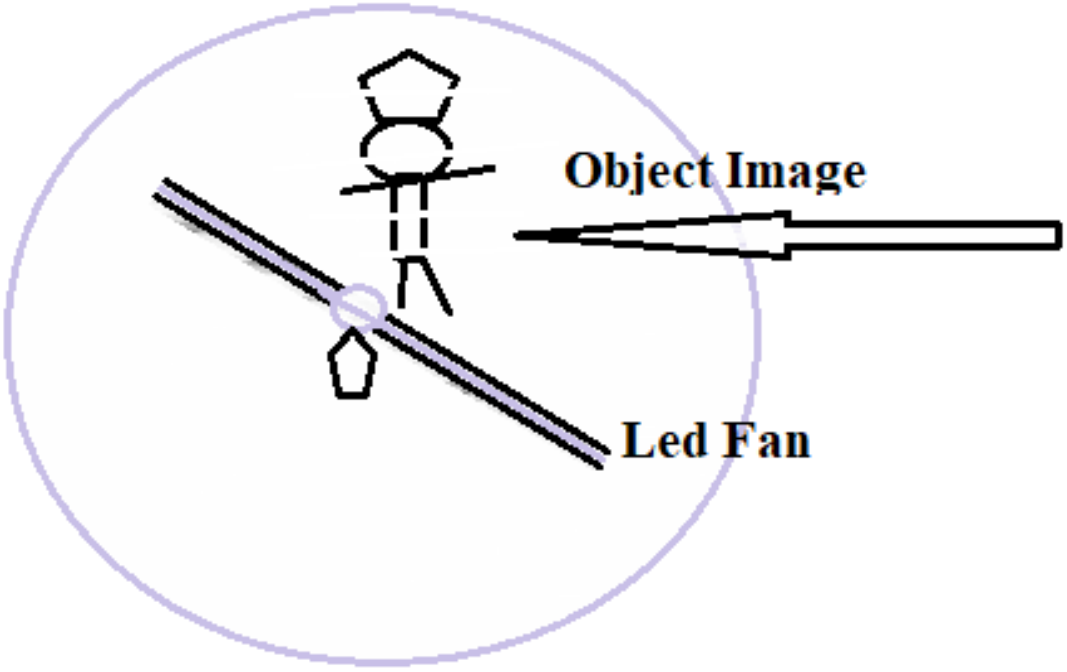

Fig5. LED FAN HOLOGRAM

The drawback of this device is that it needs a pen drive to store the images to be projected on a hologram.

6. **Proposed System**: 3D hologram projector screen
   A projector screen is basically used for projecting an object on a projection screen or wall. This device works with both online and offline devices. Because of its high resolution, this device can display more information at once, so the most interesting aspect of the projector is its display. In place of the projector screen or wall, we will replace it with some light. Light will penetrate and prevent projector output light from reaching the wall. External lighting is focused in front of the projector to create a 3D image in the air between the projector light and the external light.
   Through virtual reality and mixed reality, it is possible to create a virtual image, but it's seen by only those people who are wearing hardware devices, this image is not seen by naked eyes. Through this technology, it is possible for anyone to see the virtual image; there is no need to wear any hardware devices.

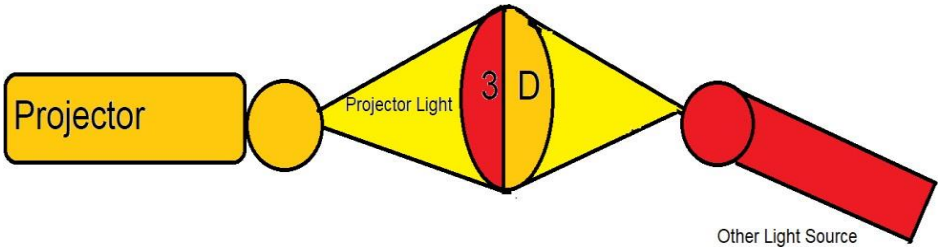

Fig6. PROJECTOR AND LIGHT SOURCE HOLOGRAM

5. Technology compare

Every technology has some limitation and advantages.

No.	Equipment name	rd ware	nitation	chnology base
	amid Hologram	amid/ glasses make a amid type shape	line	flection hologram e
	crosoft loporation hnique	mera, Hololens or HTC e	line but required uipment	ked reality displays
	tl	h resolution flat een monitor is used visualization in tangular box.	line but required cial design box	volumetric olution
	g	atial light modulators	line	reconstruction
	) Fan	lographic LED-Fan play.	line	lographic projection 3D offline
	jector Screen 3D logram	jector and External t source	line use any jector	Holographic jection online

Table 1: Technology comparison

6. Methods for computer generated hologram :

There are two methods used to synthesize a computer-generated hologram (CGH): the point-cloud model and the polygon-based model.

Point cloud:

A "point cloud" is a set of data points in space that are used for many purposes, including creating 3D CAD models for manufactured parts. Each point position has its own set of Cartesian coordinates of each point position has (X, Y, Z). Point clouds are generally produced by 3D scanners or by photogrammetric software, which measure many points on the external surfaces of objects around them to represent a 3D shape or object. [21]

Delaunay triangulation

In mathematics and computational geometry, a Delaunay triangulation (also known as a Delone triangulation) is not unique; each of the two possible triangulations that split the quadrangle into two triangles satisfies the "Delaunay condition," i.e., the requirement that the circumcircles of all triangles have empty interiors of three or higher dimensions. Generalizations are possible for metrics other than Euclidean distance. [22]

Marching cubes

is a computer graphics algorithm, published in the for extracting a polygonal mesh of an isosurface from a three-dimensional discrete scalar field. The applications of this algorithm are mainly concerned with 3-D modeling are usually called meatballs. [23]

Polygonal Modeling

In 3D computer graphics, polygonal modeling is an approach for using polygon meshes for polygonal modeling. Polygonal modeling is a real-time computer graphics method for rendering. Similar to polygonal modeling, some methods for representing 3D objects include NURBS surfaces, equation-based representations and subdivision surfaces. [24]

NURBS surfaces

Non-uniform rational basis spline (NURBS) is a mathematical model that is used both analytically and to model shapes. NURBS is used in 3D graphics and animation software packages. They can easily interact with humans. NURBS surfaces are functions of two parameters that map to a surface in three-dimensional space. The shape of the surface is determined by control points and can represent simple geometrical shapes. [25]

Equation-based representations:

For building a model from scratch, equation-based modeling languages are suitable. This model is used

to identify and predict their transient responses. Participants also had to rate their confidence in the models. [26]

Subdivision surfaces

A subdivision surface algorithm that is recursive in nature starts with a base-level polygonal mesh. This resulting mesh can be passed through the same refinement scheme again and again to produce more and more refined meshes, and each iteration is often called a subdivision level, starting at zero. [27]

Light scattering:

The scattering of light by particles is the process by which small particles scatter or change the direction of light. Maxwell's equations are the basis of theoretical and computational methods describing light scattering, In the case of geometries for which analytical solutions are typically calculated in terms of an infinite series. [28]

The size of a scattering particle is

size parameter x, which is:

$x = (2\pi r)/\lambda$

Light scattering is accomplished primarily through two ways

1. Absorption (the photons disappear)
2. Scattering (the photons change their direction)

In the context of absorption of the transmitted intensity Z is usually written:

$Z=Z_0 .10^{-\alpha x}$

Context of scattering written as:

$Z=Z_0.e^{-\tau x}$

Here α and τ are called the absorption coefficient

The Rayleigh ratio, R

The scattering angle θ, defined as

$R(\theta)=z\theta r2/ZfV$,

Where z is the intensity of the radiation

zθ is the total intensity of scattered radiation observed at an angle θ

r is the point of scattering and

V is the scattering volume.

f is a factor account of polarization phenomena.

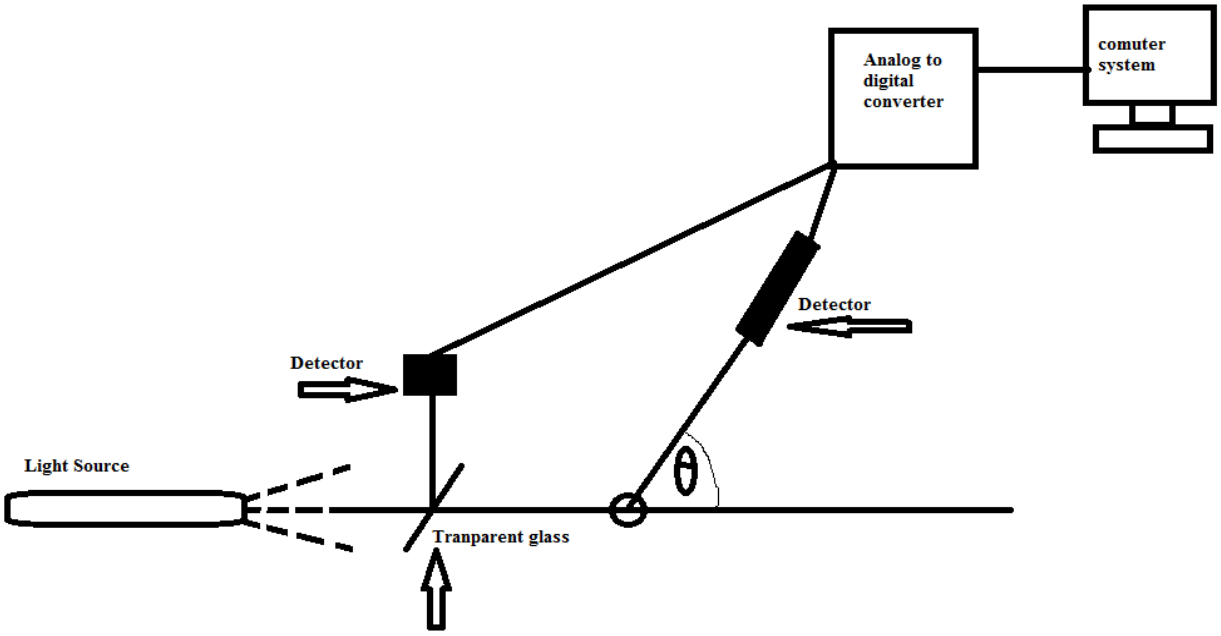

Fig7. Holographic system based on light scattering

7. MOTIVATION AND APPLICATIONS

Visualization impacts the human thought process. Many games are made in a 3D environment, but they run on a 2D screen. The thing will look real if humans and a 3D environment interact with each other. Once upon a time, we read a story in a book about a boy named Aladdin and a genie. In a cave, Aaladin found an old lamp. When Aaladin cleared the lamp, a genie came out of the lamp and told Aaladin, "My master, how can I help you?" and Aaladin talked to the genie. This artwork will include a fog and an animated image. This is a story, but in real life, it is possible to make such systems because of 3D image visualization.

8. Expected outcomes

Digital marketing and advertising: Because of changes in human psychology, advertising has become an important part of everyday life. For business purposes, this technology is very useful. These types of advertisements are very effective and attractive.

Real video calling: Because people live for each other and want to talk, meet, and share their feelings, this technology is extremely useful because a virtual image appears to be a real one.

Using this technology in the education sector: This technology is very useful for training, workshops, and FDP for interactive and attractive learning that looks like reality.

The physical world is with you, but in a more enhanced form. This technology is useful for connecting the physical world to the virtual world.

This technology can help lone people meet family members if they are separated from one another due to age or another issue, such as a COVID situation.

Medical field: easy training for medical students and live practical demonstrations so that a system is easy to understand.

Agriculture field: easy to understand crop growth systems.

9. Conclusions

This is the digitization era, where it is very popular to show everything in 3D. Transportation and holoportation are both methods of moving objects from one location to another; however, transportation involves moving a physical object, whereas holoportation involves moving a virtual object. Many changes are made from the physical to the virtual world on a regular basis. The human brain recognizes 3D images instead of 2D images, making them appear real.

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