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3-D Holographic Projections

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Abstract - 3D holographic projection is the technology that records and reproduces objects in a real 3D image. Tremendous effects on all fields of life including business, education, science, art, and healthcare. Holographic projection is a kind of 3D technology without wearing glasses, and viewers can see the three-dimensional virtual character. This paper made a more detailed description of 3D holographic projection, and explored the principle and technology about holographic projection based on computer three-dimensional graphics. It will have some reference value for the future development. The intrinsic properties of holograms make 3D holographic imaging the best candidate
for a 3D display. The holographic display is an autostereoscopic display which provides
highly realistic images with unique perspective for an arbitrary number of viewers,
motion parallax both vertically and horizontally, and focusing at different depths. The
3D content generation for this display is carried out by means of digital holography.
Digital holography implements the classic holographic principle as a two-step process of
wave front capture in the form of a 2D interference pattern and wave front reconstruction
by applying numerically or optically a reference wave.

***Key Words*:** holographic projection, 3-D technology, hologram, motion parallax, wave front

1.INTRODUCTION

Three-dimensional (3D) displays are the next generation displays. The claim for 3D imaging is
indisputable in mass television, game industry, medical imaging, computer-aided design,
automated robotic systems, air traffic control, education and cultural heritage dissemination.
The ultimate goal of 3D visual communication is 3D capture of a real-life scene that is followed by creating its scaled exact optical duplicate at a remote site instantaneously or at a later time.

2. 3-D HOLOGRAM TECHNOLOGY

The ultimate goal of digital holography is to build a system for 3D scene capture, transmission of captured data and 3D optical display, it is hard to fulfil this task because of limitations encountered at digital implementation of the holographic principle due to the discrete nature of photo-sensors and display devices, their small size and low spatial resolution. The modern devices are characterized with a pixel periods from 1 to 20 μm and active areas from 1 up to 2–3 cm2.

3D content generation from optically captured digital holograms should include three steps:

(i) multi-view capture by a set of cameras or by sequential recording from different perspectives ;

(ii) conversion of the captured data to a display data format;

(iii) feeding the data to a display from many SLMs to enlarge the viewing angle.

A key problem of digital holographic capture and imaging is the very small value of the maximum angle between the object and reference beams which satisfies sampling requirement for the spatial frequency at current low spatial resolution of electrically addressable devices. In theory, the photo-sensor must resolve the fringe pattern formed by interference of the waves scattered from all object points with the reference wave.

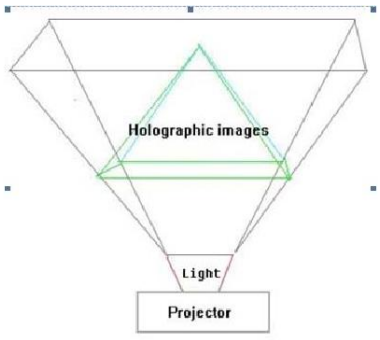

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Figure -1

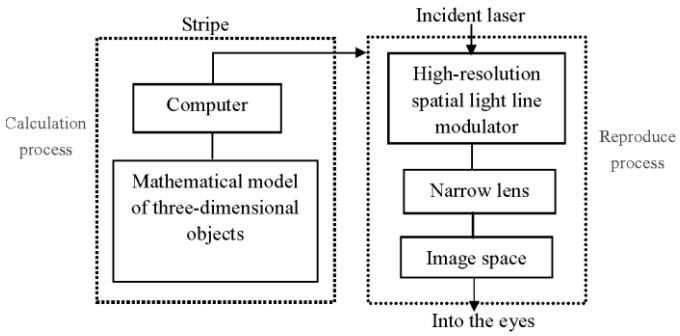
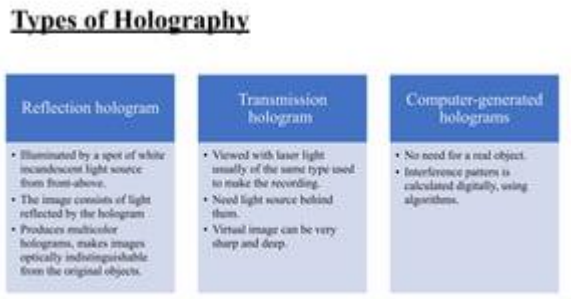


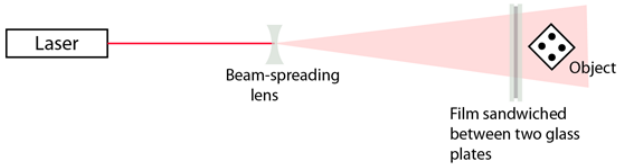
Figure-2

2.1. TYPES OF HOLOGRAPHY



2.1.1. Reflection Hologram

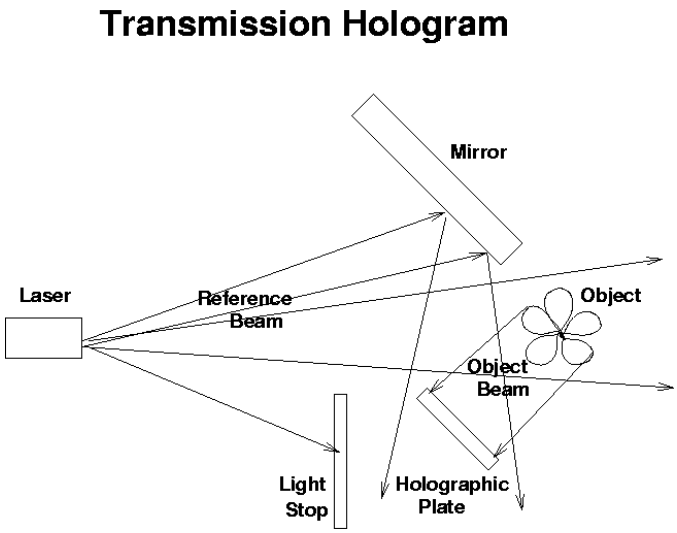
With a reflection hologram, the image is stored in a thick emulsion and can be viewed in white light. The simplest such hologram to make is the direct beam reflection hologram. In this case the direct beam through the film serves as the reference beam.



1.Adjust the laser in its holder so that the beam spreads out horizontally.
2.Place the object at a distance of 35 to 40 cm from the laser.
3.Place a white card behind the object and adjust the laser while looking at the shadow on the card. Adjust the position of the laser until the object is optimally illuminated. Then remove the white card.
4.Book as shutter
5.Place an opaque cardboard near the laser to block the light from reaching the object. This will serve like the shutter of a camera.
6.Remove a holographic plate from its container (in the darkest part of the room), and close the container.
7.Lean the holographic plate on the object, making certain it will not slip or move; the emulsion (sticky side) should touch the object.
8.Allow 10 seconds for the object to settle, and tell everyone in the room to hold still.
9.Now, lift the "shutter" slightly off the table while still blocking the laser light, and wait 2 seconds for the vibration to subside.
10.Then, lift the shutter all the way up to expose the holographic plate and object for 10 seconds (5 seconds minimum, longer is OK up to 40 seconds). Then, block the light again.
11.Finally, process the exposed holographic plate according to instructions that accompany the JD-4 (or JD-2 if you are using PFG-01 plates or film sheets).
12.Optionally, place your holographic plate in a solution of Photoflo for 20 to 30 seconds. Photoflo is a wetting agent that helps holograms turn out cleaner and clearer. It reduces streaks and promotes more uniform and quicker drying. While PhotoFlo is not required to make a hologram, it does help them look better.

2.1.2. Transmission Hologram

Transmission holograms are those that are illuminated from the back side of the film. They can either be spectral color (like you see on credit cards) or a single color. They can be made in sizes as large as a meter by two meters and as such are suitable for display applications.



- **Professional Recording Material**

PFG-03M and PFG-01 emulsions both make excellent holograms, but PFG-01 is especially good for transmission holograms.

- **Holography Diode Laser**

Class IIIa, 4mW, 650nm (red), highly stabilized, adjustable collimating lens.

- **Clothespin**
  Used to hold the laser.

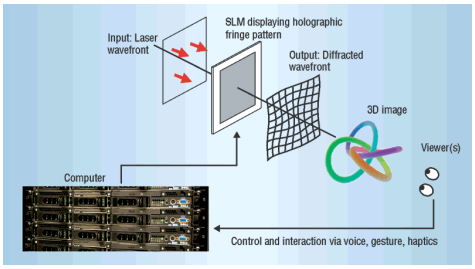
- **JD Processing Kit**
  Use the pre-measured JD-4 kit if using PFG-03M plates or JD-2 if using PFG-01 film or plates.

- **PhotoFlo**
  Wetting solution to help the holograms dry cleaner.

- **5 Developer Trays**
  Three small ones, two large ones.

2.1.3. Computer Generated Hologram

Computer-generated holography (CGH) is a technique that uses computer algorithms to generate holograms. It involves generating holographic interference patterns. A computer-generated hologram can be displayed on a dynamic holographic display, or it can be printed onto a mask or film using lithography.[1] When a hologram is printed onto a mask or film, it is then illuminated by a coherent light source to display the holographic images.



2.2. Hologram Projector

A hologram projector (also called holography pyramid or holography display), which enables 3D holographic projection.

The types of hologram projectors are:

1. Laser Transmission Hologram
2. Pulsed Holography
3. Integral Holography
4. Eminent Embossed Hologram
5. Electronic Hologram
6. Digital Hologram

3. CONCLUSIONS

Holographic imaging is a 3D imaging with all depth cues and inherent vision comfort for the viewer. That is why the last decade was marked by rapid development of methods of 3D capture and 3D content generation for holographic display, holographic projection and holographic printing. In the chapter, we considered implementation of the holographic imaging by digital means when the input data are in the form of a 2D real-valued matrix, which should encode the light wavefront coming from the 3D scene. This wavefront can be extracted from optically recorded holograms or synthesized numerically using various 3D scene descriptions. Holographic recording by digital photo-sensors or computer generation of holograms for pixelated SLMs imposes severe limitations on the space-bandwidth product of the capture/display system.

ACKNOWLEDGEMENT

This journal paper consists of most of the important & upcoming technology on the globe. This will not only help in enhancing technology to a next level but help in simplifying the things around us / environment.

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