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Use of 3D Hologram Technology in Engineering Education

Upadhye sudeep[1]
[1](*Mechanical, VVPIET/ Sholapur University, India)*

Abstract :
In this paper, the researcher presents essential information about 3DHolographic Technology, in order to understand the importance of this technology in the learning environment, and in mechanical engineering particular. He also identifies the strengths and weaknesses of 3DHolographic Technology as a teaching tool, in order to evaluate its effectiveness as an educational tool. In order to thoroughly understand the phenomenon, a survey has been carried out on a small sample of teachers in the 4 universities and therefore the questionnaire has been utilized as a data gathering technique. Findings show that, 68% of respondents confirmed the importance of 3DHT as an effective teaching tool for the future. However 32% of participants mentioned that this technology could not change the face of the technical education. Additionally, the results indicate that the main barriers to integrating 3DHT into learning environments are a) The high cost of installation and b) requirement of a high-speed Internet connection.

Keywords*: 3DHT (3Dimensional Holography Technology) H.P. (Horizontal plane) V.P. (Vertical plane)*

I. INTRODUCTION

In the past, the traditional model of learning in engineering education typically characterized as didactic instruction in which information is presented to students with little consideration of how that information is used. Caprio (1994) indicated that, in traditional learning, the teacher is the sole information giver, undertaking lectures for a large group of students and the students sitting in the classroom is passive recipients of information.

Then the era of ICT i.e. Information Communication Technology has begun with computer integrated technology to provide knowledge to the students with the help of Power point presentations, projector technology

in the classrooms etc. Now the time has changed such that interactive learning for the students is possible. Here we are discussing the use of Interactive 3D holographic technology in the classroom for engineers particularly from mechanical, design and CAD/CAM field where these people should have more imagination power than others. This paper is set in the context of usage of holographic projection in the learning environment. Its key focus is on the level of effectiveness of 3DHT as a new tool which could support teaching and learning in engineering educational institutions. For that, the paper will be directed at achieving the following objectives as well as answering the research paper questions.

II. RESEARCH PAPER OBJECTIVES:

- To understand the importance of 3DHT in our lives, and in the teaching and learning environment in particularly in engineering.
- To identify the strengths and weaknesses of 3DHT as a teaching tool.
- To identify the barriers which 3DHT faces as a teaching tool?
- Research Questionnaire.
- Will 3DHT be an efficient tool for teachers in the future?
- What difficulties could educational institutions face in engaging with this tool?

III. THE HISTORICAL BACKGROUND OF COMPUTER BASED TECHNOLOGY IN EDUCATION

The technological revolution has contributed to changes in many areas of life. In education, for example, the famous inventor, Thomas Edison, predicted that textbooks would be replaced by motion pictures (Mayer, 2005, p.8). Similar predictions were made with the emergence of the phonograph, radio

broadcasting, tape players, TV and video Despite these attempts were importance in the field of education, many experts argued that these technologies considered as the mass form of one-way information transfer. For example, public broadcasting prevents individual learning, because it does not reflect individual needs. The sequential presentations, such as tapes and videos, do not allow for working with the piece of information actually needed. Therefore these means can only play a role of supplementary specialized material.

According to Setzer:

"Increasingly, the computers of the very near future will be the private property of individuals, and this will gradually return to the individual the power to determine patterns of education. Education will become more of a private act .There will be new opportunities for imagination and originality." (Setzer, 1997, p.37) Sir Tim Berners-Lee, working at the European Laboratory for Particle Physics (CERN) in Geneva, created the World Wide Web (WWW) in 1989. However, the coming of age of the Web in the educational sector was during 1990s, when Berners-Lee had built all the tools necessary for a working Web. However, Nielsen (1995) confirmed that, the real breakthrough for the Web in the context of the learning environment was in 1993 when the easy-to-use point and click Web client Mosaic was released by NCSA (the National Centre for Supercomputing Applications). Since then the Web has been growing at an unbelievable speed and has become a system that has not only completely changed the importance of hypertext and hypermedia but has also had a strong influence on many fields of computing and information technology as a whole. Today, the Internet and virtual world support active, hands-on learning which can provide students with practical, real-life experience. According to Sandra Andrews, an educational re- searcher at Arizona State University College of Education, "The virtual world gives a greater sense of presence than discussion boards... [so] the students get a better feel for the teacher, and it is more fun" (Harrison, 2009, p.2). Hence, many studies have shown that this style of learning results in better retention and understanding of a given topic.

IV. 3D HOLOGRAM TECHNOLOGY (3DHT)

The word, hologram is composed of the Greek terms, "holos" for "whole view"; and gram mean- ing "written". A hologram is a three-dimensional record of the positive interference of laser light waves. A technical term for holography is wave front reconstruction (Universal-Hologram, 2009). Dennis Gabor, the Hungarian physicist working on advancement research for electron microscopes, discovered the basic technology of holography in 1947. However, the technique was not fully utilized until the 1960s, when laser technology was perfected. 3D Holographic Technology (3DHT) created in 1962 by scientists in both the United States and the Soviet Union. However,

3DHT has advanced notably since the 1980s owing to low-cost solid-state lasers that became easily accessible for consumers in devices such as DVD players (Chavis, 2009).

The way 3DHT operates is by creating the illusion of three-dimensional imagery. A light source is projected onto the surface of an object and scattered. A second light illuminates the object to create interference between both sources. Essentially, the two light sources interact with each other and cause diffraction, which appears as a 3D image.

Through the enormous development of technology, many scientists began to make greater use of 3DHT. indeed, scientists managed transfer of individuals from one place to another without the need to travel. This sounds like something from a science fiction movie or T.V show. But this phenomenon has already taken place in American elections in 2008, when Jessica Yellin, in Chicago, was `beamed up` into Wolf Blitzer's studio in New York with a very realistic display (Fig- ure1). This event attracted millions viewers to watch the hologram effect via a YouTube clip. In fact, "CNN Hologram" was the 22nd most searched term on Google shortly following the cover- age (Welch, 2008).

Musion System Company seamlessly integrated their 3D holographic display technology with Cisco's Telepresence system to create the world's first real time virtual presentation (Musion System, 2009). Hence, 3D Holograms have broken out of the world of science fiction and fantasy and are about to become common currency between many countries around the world. Live and life-size 3D Telepresence holograms can now interact with their remote audiences whether they are a band performing on stage, a politician delivering a keynote speech, or a CEO holding an interactive meeting with colleagues around the world.

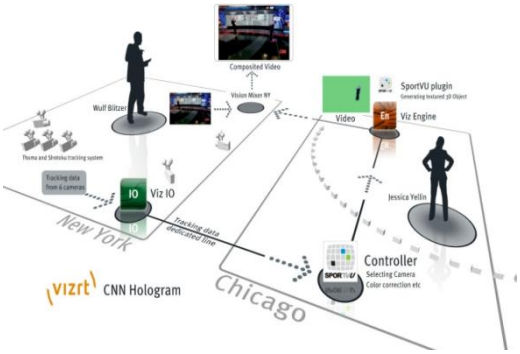


Figure1: A diagram of the CNN Hologram (Serrao, 2008)

V. HOW 3DHT WILL HELP STUDENTS TO IMAGINE AND VIEW.

While studying mechanical engineering one has to to undergo subjects like Engineering Graphics, Engineering Drawing where he must have the power of imagination to answer the questions.
If we enlist the different topics one has to study at this level these are

- Projection of solids
- Projection of planes
- Section of Solids
- Development of Solids
- Perspective Views
- Isometric views
- Assembly drawing
- Details drawing
- Orthographic projection etc.

Let's consider one problem of projection of hexagonal pyramid which is resting on its base and a corner which is made to be tilted such that its two base sides are parallel to vertical plane.
Above problem while solved with pencil and paper technique will look like.

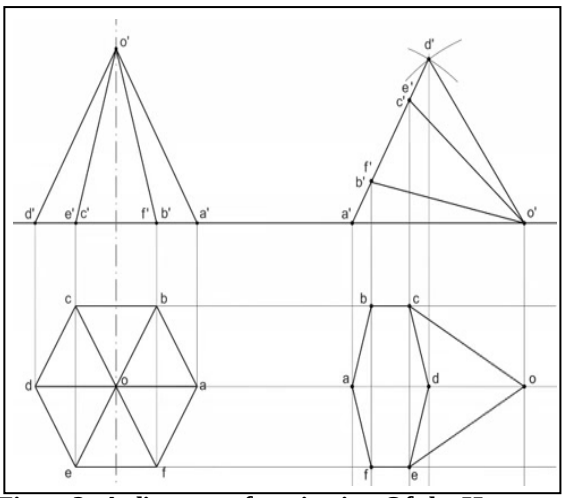
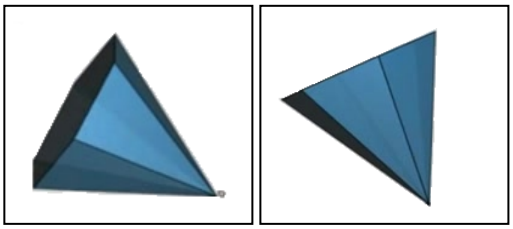


Figure2: A diagram of projection Of the Hexagonal pyramid.

With the help of 3DHT one can get the perspective and isometric view as below



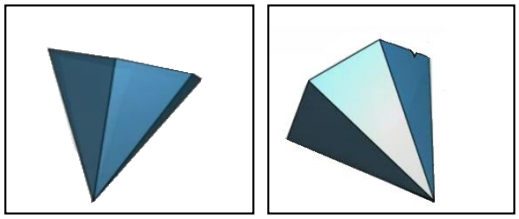


Figure3: A diagram of different views of pyramid

A example of 3D holographic projection is shown below here a helicopter has projected holographically on a coffee table such that a person can view its different views by moving around it

This makes it very interesting to view different angle of a object which is very needed in case of imagination. The importance of 3DHT on education

In this area we can take advantage of 3DHT in different forms. For example, holograms now allow students to be taught by a "virtual teacher" who could be many kilometers away. The process goes a step beyond video conferencing in that the hologram teacher appears to be in the classroom, and can see and speak to the pupils as if they were all in the same room. Moreover, 3DHT can enhance the educational process by bringing famous characters to life again from the past, and they speak about themselves and/or explain something as an assistant teacher. For instance, there have certainly been many worthy philosophers and learned men in world history perhaps none more celebrated that the Greek Philosopher Plato. Unfortunately we are unable to talk with Plato as he is from a past period, while we are in the present period moving into the future period by hologram. In Seoul's Alive Gallery Project, holograms and 3-D animation technology bring 62 world-renowned masterpieces of Western art to life again. In this project we can see the Mona Lisa answering questions from students, such as "Why don't you have any eyebrows?" she is answering, "When I was alive, a woman who had big forehead was considered a beauty … so most women had their eyebrows taken off for beauty". Or, Michelangelo explains the fresco technique he is using to paint "The Last Judgment". He explains the work of another masterpiece he had completed earlier on the ceiling of the Sistine Chapel. A pop-up screen shows a close-up of the famous "Creation of Adam" (Cho, 2008, p.1).

However, 3DHT, as does any technology, has some disadvantages. Firstly, there is the problem of price. Secondly, 3DHT needs to be connected to a fast Internet, next-generation broadband Inter-

Network with a minimum guaranteed constant speed of 20 megabits per second. Finally, to use this technology perfectly, we will need a screening room with compatible lighting and video technology, which costs around 150,000 US dollars to install, as well as a display screen for viewing the holograms

on, priced at around 215,000 US dollars (Bobolicu, 2009).

Nevertheless, Ian O'Connell, director of Musion, a company that is pioneering the use of live hologram technology, believes that this sort of fixture will be a mainstay in many sectors in the future, perhaps even within the next five years. "It's going to necessitate a change in architectural design for residential homes for it to be embraced fully," he said. "It's going to need a room that can accommodate the screening and delivery technology. But I think we're five years away from holograms being a ubiquitous, affordable tool" (Bobolicu, 2009, p.2).

VI. THE METHODOLOGY AND DATA ANALYSIS

DATA COLLECTION METHODS

Hurt (2005) states that the survey is often used to describe frequencies of behaviors and attitudes and sometimes to recognize relationships between variables, correlations which we want to emphasis on. Hence, In order to answer the paper questions as well as achieving the objectives, a survey has been carried out on a sample of teachers in the local region, and therefore the questionnaire has been utilized as a data gathering technique. According to Oates (2006, p.219) the questionnaire is a set of pre-defined questions to be answered by a number of respondents in order to provide specific data. Hence, a questionnaire was distributed to 200 teachers working in various engineering institutes. In order to maximize validity by standardizing the sample, the researcher explained the purpose of the study and gave an introduction to the 3DHT of all respondents to know what the meaning of this technology. Moreover, he clarified concisely all questions of the questionnaire before each teacher and lecturer started filling it out. The researcher carried out follow-ups with the participants according to what participants identified as areas in which they needed help and once teachers complete the questionnaires, the researcher has collected them straight away. Each question in the questionnaire has been evaluated by using a pilot study or must be pilot tested before the final administration. This procedure is vital for any questionnaire in order to evaluate how respondents interpret the question's meaning and also to check if the range of response alternatives is sufficient. Furthermore, it is also important to evaluate how to phrase each question, layout, check the wording in the questions to avoid potential confusion (De Vaus, 2002). The pilot study suggested that the questionnaires appeared to be an effective method of collecting a large amount of relatively basic information in a short space of time.

DATA ANALYSIS AND FINDINGS

The survey was conducted during the period of the 4th to 26th of November 2012. The researcher sent out the questionnaires to the 200 teachers. All questionnaires were returned; this meaning all the population had participated.

UNIVERSITY	**NO OF TEACHERS INVOLVED**	**YES**	**NO**	**%**	
PUNE,MAHARASHTRA	50	36	14	72	28
SHIVAJI, MAHARASHTRA	50	30	20	60	40
SOLAPUR,MAHARASHTRA	50	26	24	52	48
JNTU,HEYDERABAD	**50**	44	6	88	12

First of all, the researcher wants to know the relationship between the teachers from different institutes and their thoughts on whether 3DHT will enhance learning. The table shows that (68%) of respondents said "Yes", whereas (32%) said "No". These proportions clarified that there is a large percentage of respondents believe that, the hologram technology will support the learning process. Overall, the results showed some interesting points related to the use of 3DHT as a teaching tool as well as the reasons that hinder its integration into the learning environment. For example, the majority of respondents confirmed that 3DHT reinforces the learning process, as well as potentially being an effective teaching tool for the future. However, most participants mentioned that this technology does not change the face of education. Moreover, the main barriers that may hinder the integration of 3DHT into the learning environment are the high cost of installation and requirement of a high-speed Internet connection.

VII. CONCLUSION

This technology led the researcher to investigate whether 3DHT will be an effective tool for the teachers in the future. Furthermore, the researchers wished o explore the main barriers that might prevent 3DHT being integrated into a learning environment. In order to move towards an answer in this issue, the researcher posed

the following questions;

1. Will 3DHT be an efficient tool for teachers in the future?

The researcher noted that, 68% of respondents have confirmed the importance of 3DHT as an efficient tool for teachers while 32% of teacher mentioned that this technology could not change the face of education, but it could help them to some extent in their teaching.

2. What are the difficulties, which educational institutes could face in engaging with this tool?

According to the study findings, the main barriers that may hinder the integration of 3DHT into learning environments are 'needing a high cost of installation' and 'needing high speed Internet'. Although 95% of all participants indicated that 3DHT is very expensive and difficult to integrate it with the learning environment, the researcher believes that it is very interesting to use this technology in the teaching process even if it is very expensive to implement at present.

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