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Hologram Technology for Effective Learning: A review

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Abstract: Learning is the difficult process. Understanding complex theoretical things without clear visualization is very difficult. Hologram technology can solve this problem. From technical education to medical and even in nursery education hologram technology can be deployed to teach students with more conceptual clarity. With swept-volumetric display technology, we can make portable and user-friendly devices that may be used by educational institutions and teachers for effective teaching. This technology can help to bring in more conceptual clarity, enable visualization of concepts, and ensure efficient communication between learners and educators. Using the hologram technology, the technical, medical, nursery and all other teaching –learning processes can be made more effective and interesting. In thispaper the technological aspects of volumetric display hologram technology along with its integration in educational institutions is critically discussed.

Keywords: Hologram technology, volumetric display technology, swept volume display.

I. INTRODUCTION

Modern technology has completely reshaped the entire education system over a period of time. In this age, the educationis available to everyone because of the internet. In modern era classrooms are also equipped with modern technologies like smart boards and digital multipurpose LCD screens. Other than these some other technologies which are developedrecently can also be used by educational institutions and teachers to educate students. Technology that can be used in theeducation ecosystem to teach students more effectively is Hologram technology. With the help of this technology, visualizing complex things becomes easier for students. But learning is a difficult process and in the technical educationor medical education, there are lots of concepts that a student needs to visualize for fully understanding the topic. Just like a chemical reaction, students need to imagine the whole 3-D process to understand the mechanism and logic behindthe reaction. In physics, to understand the magnetic or electrical phenomena in motors, transformers, inductors, or any kind of circuit, students need to visualize the whole particle movement and theoretical magnetic line in mind. Even in medical studies, students need to visualize the human anatomy, human nervous system, blood flow, cell working, etc. which is indeed a herculean task. The Teachers also face difficulties when they explain these complex things to the students. Hologram technology is the answer for visualization of critical and complex things. In nursery education, kidscan learn the things more effectively using hologram technology. If we teach them with holograms, then they can remember the concepts for a longer time and can grasp them easily.

II. ANALYSIS

Hologram technology is a three-dimensional projection method which can create a 3d image or holographic image that can be seen without using any special equipment such as cameras or glasses. The image, also called a holographic imagecan be viewed from any angle, so the students can take a complete look at how a particular thing works. Many types of hologram technologies can produce holographic images, like RGB fan-type holograms, autonomous drone-type holograms, laser-plasma holograms, and many others. But for educational purposes, volumetric display-type holograms[1-5] are best due to their user-friendly and easy-to-install nature. It is also a user-friendly technology that can be used by old teachers as well.

The three types of volumetric displays are:

1> swept volume display2> static volume display3> Free space displays

Out of these three methods, swept-volume displays and static volume displays are the most well-developed methods that can be integrated into classrooms for effective learning. [9] The free space display hologram, is the most futuristic and high-resolution hologram creating technique but it is not fully developed. In Swept-volume display hologram[6-11]the laser light beams are projected to a display that includes illuminated spinning screens, spinning LEDs or translating projection surfaces.
This kind of display uses a coated paddle (like phosphor-coated) or screen that spins inside a glass chamber under vacuum to reduce the air resistance during its spinning time. An electron beam hitting the paddle createsa point emitting visible light. Steering the

electron beam and spinning the screen creates a volumetric image from the emissive points. This 3d image can be visible from any direction. 24 frames per second (FPS) is the standard for films and that is enough for us to interpret motion. A swept-volume display needs to achieve similar results at every "pixel" of resolution in the Z axis so that we can smoothly see the projection. To put this into perspective, if you want a500x500x500 24 FPS resolution volumetric display, you would need to move a 2D 500x500 display up and down and at 12,000 FPS to make 24 FPS for each of the 500 Z axis pixels.

LCD refresh rates top out at around 480 Hz which is not enough, so we need to use laser projection. Instead of moving an entire display up and down, a couple of stepper motors can be used to move a thin panel of translucent film in the Z axis. In this kind of device, we need to take a 3D model and it should be cut layer by layer from above and arranged side by side. After that we need to synchronize the frequency of the spinning panel and projection of the laser light. Static-volume displays might form images by up conversion in nonlinear gases or solids (like glass) or by projecting onto several diffusing planes. In this method, a glass chamber filled with gases is used as a 3D screen. A 3-D position within that gas is illuminated with two beams at wavelengths which is not visible to the human eye. These two wavelengths combine in the nonlinear material to produce visible light which scatters from that position to form an emissive image point; scanning the two beams createsa volumetric or 3-D image.

Out of these types and methods of hologram, swept volumetric display type holograms are the most practical and most user-friendly system [12-14]. With the help of this swept volumetric display type hologram technology, we can build a portable and user-friendly hologram machine that can be used by educational institutions to teach complex topic and theories to students. This kind of device can be installed in classrooms just like 2d projectors. With the help of this technology, teachers can also teach complex scientific theories very easily with visualization. With this visualization methodology, students also get a very deep and clear knowledge of what they are studying. By integrating this above mentioned sweptvolumetric hologram methodology, we can make technical and medical studies more effective and more interesting. To integrate this hologram technology in our education sector, we first need to build a portable machine that can project a clear hologram.

This machine should be economical and easy to operate. If this comparatively new technology is integrated in the education sector, then not only the education sector will be benefitted, rather than that the ongoing research will also gain momentum. In the education sector, especially the technical and medical studies, visualizing things plays a major role. Although, these days' institutions use smart boards and animations to explain theories, reactions, and3d models, but a three-dimensional thing can be perfectly explained only in three dimensional space. When we try to fita 3d model in a 2d plane or a 2d display we need to distort the actual shape or we need to use the animation. Making an animation requires skill and time as well. If we want to make a true original animation of a three-dimensional object, weneed to make a 3D model of that using some software, or we need to draw that particular thing frame by frame in every angle to make an understandable animation for students. Both methods require time and money as well. With a 3d display,we can easily make a hologram of a real or CG 3d model by simply making a three-dimensional figure in 3D graphic designing software like blender. So teachers can directly use the 3D model as a hologram to explain the concepts.

Some more research is to be carried for this technology as it is still underdeveloped. Due to developing and less awareness about this technology, educational institutions are unable to integrate this revolutionary and awesome technology in theirclassrooms.

III CONCLUSION

Volumetric display hologram is a new technology and the majority of the educational institutions are not using this technology to teach the students. This technology has lots of potentials. It can change the whole education sector by its unique visualization methodology. In learning processes, visualization is more effective than reading, so with this visualization methodology, students can easily grasp the concepts and remember them for a longer time.

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