Le Voyageur Temps

Hologram the future of medicine – From Star Wars to clinical imaging

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“Help me, Obi-Wan Kenobi”.

The famous words spoken by Princess Leia in a hologram, projected from the droid R2D2 in Star Wars was perhaps first introduction to humankind in general of this concept. Since that time there is a huge progress in this technology so much so that it has become from fantasy to a reality. With humankind moving from invasive surgical therapies to minimally invasive interventional options, there is currently a felt need for live 3D image guidance to supplement mere 2D image guidance. Live X-ray and live 3D cardiac ultrasound imaging could be used simultaneously to guide minimally-invasive structural heart repair procedures, with the ultrasound images providing detailed insights into the heart’s soft tissue anatomy, and the X-ray imaging providing visualization of catheters and heart implants. Medical holography is actually integration of all these modalities. While, current 3D viewing technologies are not able to create a truly accurate 3D rendition; they are really 2D images gathered from MRI, CT scanner, ultrasound and other devices, stitched together to create a rough 3D image. Furthermore, it is extremely laborious and time consuming to create 3D visualizations from these 2D images. This makes treatment and diagnostic decisions based on these images rather challenging, plus their accuracy is often questionable. Here medical holography can be the answer. By rendering these 2D images into 3D floating projections, this technology will revolutionize the way medical professionals plan and carry out their treatments and surgeries. The technology will enable physicians to zoom in and out of the images to get a better view of parts that are unclear in the initial scans (Figs. 1 and 2).

While a Hollywood movie makes this type of technology look easy, but in the real world, use of classical holographic technology had resulted in relatively primitive designs. But now we are witness to another major development in holographic technology. True3D Viewer, EchoPixel aims to solve this problem by providing medical professionals with a hologram of organs that can be moved around, zoomed in on, or manipulated in actual 3D space. The new technology might not necessarily improve medical practices by leaps and bounds, but it can make diagnosis and treatment processes more effective. Further, this 3D holography could avoid uncomfortable physical procedures and help detect problems in complex organs such as the heart or the brain.

1. Definition

The term “hologram” (“holos” meaning “complete” and “gram” meaning “message”) has long been used to refer to both the technique of wavefront reconstruction (by interference, diffraction and reflection) and an image genre – a virtual encounter between an immaterial, usually-3D image of an absent human and living humans.

2. Uses in medicine

1. Recently, Royal Philips and RealView Imaging reported a clinical study demonstrating the feasibility of using an innovative live 3D holographic visualization and interaction technology to guide minimally-invasive structural heart disease procedures. The study involved 8 patients and was conducted in collaboration with the Schneider Children’s Medical Center in Petach Tikva, Israel. RealView’s visualization technology was used to display interactive, real-time 3D holographic images acquired by Philips’ interventional X-ray and cardiac ultrasound systems. As a consequence, in addition to viewing the patient’s heart or a 2D screen, interventional cardiologists were able to view detailed dynamic 3D holographic images of the heart ‘floating in free space’ during an interventional structural heart disease procedure, without using special eyewear. The physicians were also able to manipulate the projected 3D heart structures by literally touching the holographic volumes in front of them. The study demonstrated the potential of the technology to enhance the context and guidance of structural heart repairs. The holographic projections enabled not only to intuitively understand and interrogate the 3D spatial anatomy of the patient’s heart, but also to navigate and appreciate the device-tissue interaction during the procedure.

2. Another area where this technology may be useful is medical education. It may now be possible to deliver a presentation from a remote setting – a 3D, high-resolution, full size image of presenter could be projected on stage, into a special podium, in front of a live audience thousands of kilometers away, allowing “virtual lectures.” The lecturer could conduct the lecture in real time and interact with the audience on the other end; even make eye contact with students in the audience.

3. These technologies can also provide live simulations for students to learn a procedure.

4. Other applications could include telemedicine, 3D mapping technologies, remote guidance during emergency situations, remote video conferencing, manufacturing, and a myriad of others.
3. Device industry

There are several companies that produce true hologram systems that are specifically targeted at the medical sector.

1. EchoPixel (U.S.), produces the True 3D Viewer (t3D), a software system that converts 2D images to stereoscopic 3D images. The system makes it possible for medical professionals in diagnostics, surgical planning and interventional cardiology/radiology to 'cut' virtual tissue, organs and other body parts at various angles. This enables the image specialists and interventionists/surgeons to create an unlimited number of cross sections and to manipulate the image in such a way that abnormal tissue growth in any organ can be identified. It can also be used to plan an intervention. Recently, FDA has approved the system.

2. Another company is Zebra Imaging produces the ZScape (U.S.) – a table-top style holographic display system. This is an excellent alternative in situations where there's a lack of cadavers for medical students to dissect. It allows the students to navigate the entire body and sifting through skin layers, muscles, the cardiovascular system and the skeleton.

3. Other major players in the global medical holography market are Realview Imaging Ltd. (Israel), Mach7 Technologies Pte. Ltd. (Australia), Ovizio Imaging systems (Belgium), Holoxica Ltd. (U.K.), Lyncee Tec (Switzerland), Eon Reality (U.S.), Zebra Imaging (U.S.), and NanoLive SA (Switzerland).

4. Conclusions

Holography will significantly disrupt 3D imaging, as it offers better usability and addresses the shortcomings of current 3D solutions. It has the potential to impact each and every aspect of life but particularly, it can be a game changer in medical industries. Progress in image-guided therapies for heart diseases has opened new frontiers for minimally invasive, non-surgical interventions; coronary interventions, catheter ablation therapy for arrhythmias and catheter-based structural heart therapies including heart valve replacements.

Conflicts of interest

The author has none to declare.

References

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