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Glassless 3D Technology
A 3D Solution without glasses - the future of 3D Technology

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Abstract: **Today it's hard to find a person who's never heard about 3D technology. With the popularity of 3D tablets, 3D TV sets, 3D laptops and 3D smartphones on the rise it's no wonder that more and more people are getting interested in the nature of three dimensional technology. 3D vision has started with the invention of stereoscopic 3D concept and has gradually evolved to many modern methods of 3D technology. So if you can tell the difference between anaglyph red cyan, polarized and shutter 3D glasses, you definitely have a clear perception of what 3D is and how it works . Most of us associate 3D technology with the use of special glasses or virtual reality headgear to filter what image each of our eyes sees. But what do we know about 3D without glasses? Is it just a futuristic concept or already a reality?**

How 3D without glasses works?

The technology of 3D without glasses is called auto-stereoscopy. Because this kind of three dimensional technologies doesn't utilize special spectacles or headgear it became also known as glasses-less 3D or glasses free 3D.

Auto-stereoscopy is a method of displaying stereoscopic images (adding binocular perception of 3D depth) without the use of special headgear or glasses on the part of the viewer. Because headgear is not required, it is also called "glasses-free 3D" or "glasses less 3D".

The visible world around us has three dimensions: **width (X), height (Y) and depth (Z).**

In order to experience depth, we require information from the other two perspectives. Each of our eyes picks up a slightly different image and, thanks to this information, our brain is able to draw conclusions about how far away an object is from us and this allows us to experience 3D with auto-stereoscopy technology.

Glasses less 3D is based on two different approaches of viewing:

eye-tracking and **multiple views**. The **eye-tracking system** was first implemented in autostereoscopic 3D displays by Reinhard Boerner in 1985.

Those 3D displays with eye-tracking employed provided high resolution, but were limited to a single viewer only. That's why eye-tracking approach can't be widely used for consumer products. The alternative concept is **multiple views** technique that has swiftly become the next best thing in the development of glasses-free 3D. This particular approach is based on sending imagery to multiple regions of viewing at once, thus enabling several viewing zones. Today this concept is implemented in the most flat panel displays, because it allows simultaneous viewing for multiple spectators.

The methods of 3D technology without glasses include a parallax barrier, lenticular, volumetric and holographic techniques.

Glasses-less 3D Methods

1) Parallax barrier

This method is widely used in modern **3D liquid crystal displays**. **Parallax barrier** is a special device with a

series of precision slits that's placed in front of LCD, serving as a filter for output image perception. The slits allow left and right eye to see their corresponding image, which is produced by a different set of pixels. That's how the illusion of 3D vision is created by parallax barriers. To have a clearer understanding of this method see the image - it should help a lot.

The **examples of parallax barrier** employed in consumer products are Nintendo 3DS game console, HTC EVO 3D and LG Optimus 3D smartphones. Also used in Range Rover's navigation system, the parallax method allows both the driver to view GPS directions and a passenger to watch movies from the same display simultaneously.

However, the parallax method is not perfect, because it has some **disadvantages**. First one is that in order to experience stereoscopic 3D effect the viewer must be positioned at a certain angle to the display. That's actually not a big problem if we're talking about video game consoles or smartphones, but not good when it comes to 3D TV sets, laptops etc. Another constraint is that the count of horizontal pixels that work to create a different image for each eye is limited to one half.

2) Lenticular lens

The second mostly used method of **glasses free 3D** is **lenticular lens** technique. You may have heard about lenticular printing that creates the illusion of depth, haven't you? If not then you should know that an autostereoscopic 3D display with lenticular lenses utilized is actually the same technique as lenticular printing. Generally speaking the **lenticular method** is based on the use of **magnifying lenses**. Those lenses are set in arrays to produce slightly different images when viewed from different angles. They are also constructed in such way that when you see the image from one angle and then move to another angle the image changes as well and even moves (see the image).

The technique of lenticular lenses as a method of receiving a glasses-free 3D image is executed in Nintendo 3DS and **iPhone** and **iPod touch** in the form of third-party hardware overlay & screens.

Lenticular lens Work method

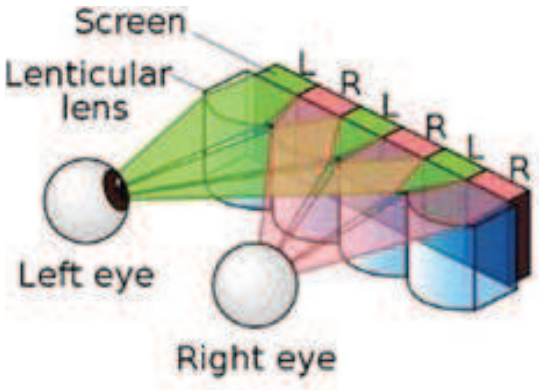

Image 2a

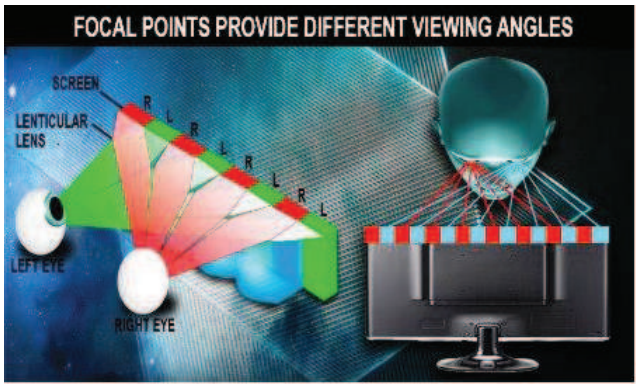

Image – 2b

3) Volumetric displays

Another type of **autostereoscopic 3D** is a **volumetric display**. This method relates to the construction of three dimensional images by means of various physical mechanisms. Volumetric displays use **light fields** to reconstruct 3D object in the volume of space. The created 3D images are thus measured in **voxels** (volumetric pixels) and can be seen with the unaided eye. A good example of volumetric imaging

devices are 3D displays used for **tomography** (see the image below).

The main advantage of volumetric displays is that they allow **automultiscopic** (auto stereoscopic multiple viewing) 3D experience.

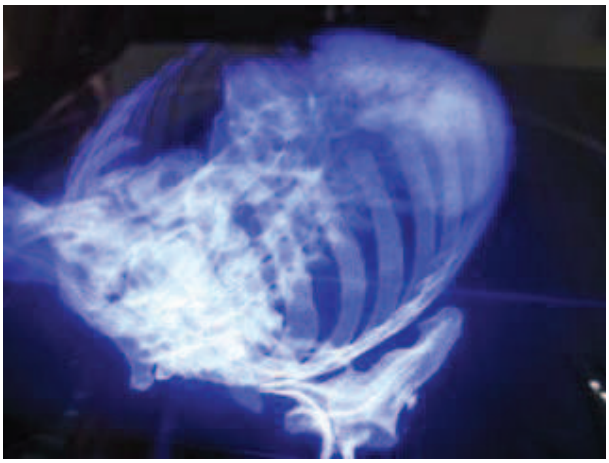

Image - Va1

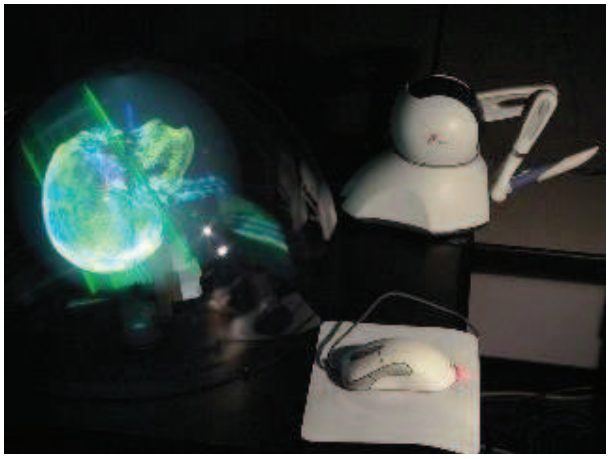

Image -Va2

4) Holographic displays

The method of **holography** is based on reconstructing **3D objects** using **light recording**. A hologram is created when an interference of several electromagnetic waves with equal frequencies occurs. During a hologram recording two electromagnetic waves intersect: the main wave is emanated from the source while the second one is reflected from the object that's being recorded. A pattern of such interference leaves an imprint on some recording medium (photographic plate or other) placed in the interference area.

Holography today is used in modern holographic displays with **lasers** being the main light source. Lasers are utilized mainly because they are powerful light beams and have a fixed wavelength. The spreading of holographic 3D displays is wide in the artistic field; usually this process is combined with music and computer graphics.

The recent most notable **artistic use of holographic display** took place on April 15th earlier this year at 2012 Coachella Valley Music & Arts Festival.

The Tupac Hologram: The Act that Kick started the Hologram Trend

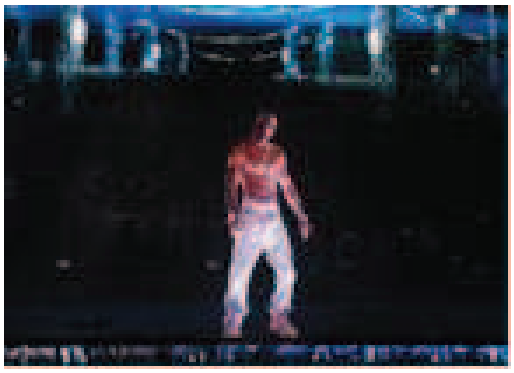

Image -- Th1

Image – Th2

There a hologram of deceased famous rapper Tupac Shakur was projected on the stage, giving a lifelike 3D music performance, soon many artists and groups recreated Holograms of Michel Jackson and other Artist in Musical concerts.

It's important to note that 3d technology without glasses isn't new; it has been used in a limited way with televisions. What is new with this research is its potential

application to the film industry along with improvements in picture quality.

Market experts have stressed that “it remains to be seen whether the approach is financially feasible enough to scale up to a full-blown theatre”, but went on to say “we are optimistic that this is an important next step in developing glasses-free 3D for large spaces like movie theatres and auditoriums.”

It could take a while for the technology to get to a stage where it can be used in multiplexes, and the market may need convincing to adopt something which is expected to cost a lot of money. It could prove to be attractive to the advertising industry who may want to use it for billboards, allowing the technology to be introduced at incrementally larger stages.

Image -- Avh1

The thought of seeing James Cameron’s next Avatar instalment or the latest high-octane thriller played out in 3D without glasses could push the technology forward and get people to return in droves to the silver screen.

With the constant development of 3D technology and the new inventions of our technological age the 3D glasses as we know them will soon become a thing of the past. So whether you are a fan of 3D or not you simply can't deny that 3D without glasses is the future of 3D vision. When it becomes a common practice and employed in the most devices all the last doubts will fall away.

About the author

Mr. M. Venkatesan is a Media Technology Consultant & Entrepreneur. He heads the technology company, Sai Media Productions (www.saiproductionsindia.com) engaged in IT, Film Production Technology & Ad Media Industry projects in India & Canada. A professionally qualified person with D.F.M & PGD. D.F.Tech, and BSc-IT, he has represented India in various international forums and technology events and film festivals. As an active technologist, writer & global entrepreneur and a key south Indian filmmaker in the Indo-Canadian international delegation to Canada, he has contributed and participated for the landmark Indo-Canadian Co-Production Pact “Audio-Visual Co-Production Treaty" signed between India and Canada, at Toronto in Sep 2015.