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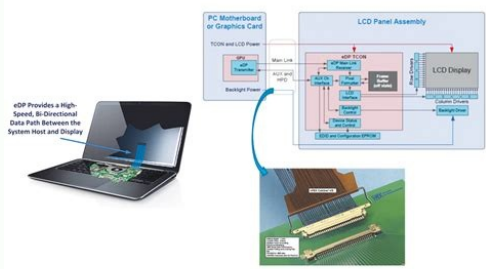
Edp 1.4 specification pdf

Edp 1.4 specification. Pdf 1.4 specification.

eDP v1.4a incorporates VESA Display Stream Compression, enables new segmented panel display architecture and increases panel resolution support to up to 8K NEWARK, CA - February 9, 2015 - The Video Electronics Standards Association (VESA®) today published the Embedded DisplayPort (eDP) Standard version 1.4a. Replacing eDP v1.4, published in February 2013, eDP 1.4a enables a higher video data transfer rate for increased panel resolution, greater color depth and higher refresh rates. It also incorporates the VESA Display Stream Compression (DSC) Standard v1.1, and includes a new segmented panel architecture that enables higher panel integration. These and other refinements were made to the eDP 1.4a standard to take advantage of higher GPU video performance and newer display technologies, while also enabling reduced system power and form factor. The eDP v1.4a standard leverages the VESA DisplayPort (DP) Standard v1.3, published in September 2014, as a base specification. That standard's new higher HBR3 link rate, which operates at 8.1 Gbps per lane, is now also part of eDP v1.4a. With both HBR3 and the DSC v1.1 standard included, the latest eDP standard can support embedded panels with up to 8K resolution. For embedded display applications, DSC is most often used to decrease video interface data rate or wire count, as well as reduce display frame buffer size, thereby reducing system power usage to extend battery life. It also enables reductions in system complexity and form factor.



An entirely new feature in eDP v1.4a is "Multi-SST Operation," or MSO, which supports a new type of display architecture that VESA calls "Segmented Panel Display." Segmented Panel Display is designed to enable thinner, lighter and lower-cost panels that use less power. In operation, MSO allows the four high-speed eDP data lanes within the eDP interface to be divided up between either two or four independent panel segments. For lower resolutions, two lanes can be used to support two panel segments. This panel segmentation enables a higher level of integration on high-resolution displays; each segment can contain a separate timing controller with integrated source drivers. According to Vice President Bong-Hyun You of Samsung Display Co., Ltd., "The Multi-SST Architecture enables greater design flexibility and power savings in new LCD panel technologies for embedded high resolution displays. Samsung proposed this feature in order to permit panel makers to make even broader usage of the eDP interface in advanced panels, as well as reduce panel thickness, reduce power draw, and reduce cost." eDP 1.4a also includes refinements to the partial update capability for Panel Self Refresh (PSR) that was introduced in eDP 1.4. Partial update enables the system video processor, or GPU, to update only the portion of the display that has changed since the video frame update, further saving system power. According to Craig Wiley, senior director of marketing at Parade Technologies, VESA board member, and editor for eDP 1.4a, "The adoption of eDP for embedded displays is now positioned for growth as eDP 1.4a has become highly optimized, especially at resolutions above quad HD. Compared to other embedded interfaces, it has the richest feature set along with the lowest power, wire count and EMI radiation, particularly when used with high-resolution panels. It will continue to evolve, along with DisplayPort, but with its own unique features specifically optimized for embedded applications such as all-in-one PCs, notebooks, tablets and smart phones." It is anticipated that eDP 1.4a will be used within systems by 2016. The eDP v1.4a Standard is available to VESA members. For more information, please visit www.vesa.org. Photo - Digital display interface DisplayPort Type Digital audio/video connectorProduction historyDesigner VESADesigned May 2006Manufacturer VariousProduced 2008–presentSuperseded DVI, VGA, SCART, RGB ComponentSuperseded by NoneGeneral specificationsLength VariousHot pluggable YesExternal YesAudio signal Optional; 1–8 channels, 16 or 24-bit linear PCM; 32–192 kHz sampling rate; maximum bitrate 36,864 kbit/s (4,608 kB/s)Video signal Optional, maximum resolution limited by available bandwidthPins 20 pins for external connectors on desktops, notebooks, graphics cards, monitors, etc.



and 30/20 pins for internal connections between graphics engines and built-in flat panels.ElectricalSignal +3.3 VMax. voltage 16.0 VMax. current 0.5 ADataData signal YesBitrate 1.62, 2.7, 5.4, 8.1, or 20 Gbit/s data rate per lane; 1, 2, or 4 lanes; (effective total 5.184, 8.64, 17.28, 25.92, or 77.37 Gbit/s for 4-lane link); 2 or 720 Mbit/s (effectively 1 or 576 Mbit/s) for the auxiliary channel.Protocol Micro-packetPinout External connector (source-side) on PCBPin 1 ML Lane 0 (p)Pin 2 GND GroundPin 3 ML Lane 0 (n)Pin 4 ML Lane 1 (p)Pin 5 GND GroundPin 6 ML Lane 1 (n)Pin 7 ML Lane 2 (p)Pin 8 GND GroundPin 9 ML Lane 2 (n)Pin 10 Lane 3 (+)Pin 11 GND GroundPin 12 ML Lane 3 (n)Pin 13 CONF1G1 Connected to groundPin 14 CONF1G2 Connected to groundPin 15 AUX CH (p) Auxiliary channel (+)Pin 16 GND GroundPin 17 AUX CH (n) Auxiliary channel (–)Pin 18 Hot plug Hot plug detectPin 19 Return Return for powerPin 20 DP PWR Power for connector (3.3 V 500 mA) ^ a b c d e f g h This is the pinout for source-side connector, the sink-side connector pinout will have lanes 0–3 reversed in order; i.e., lane 3 will be on pin 1(n) and 3(p) while lane 0 will be on pin 10(n) and 12(p). ^ a b Pins 13 and 14 may either be directly connected to ground or connected to ground through a pull-down device. DisplayPort connector A DisplayPort port (top right) near an Ethernet port and a USB port DisplayPort (DP) is a digital display interface developed by a consortium of PC and chip manufacturers and standardized by the Video Electronics Standards Association (VESA). It is primarily used to connect a video source to a display device such as a computer monitor. It can also carry audio, USB, and other forms of data.[1] DisplayPort was designed to replace VGA, FPD-Link, and Digital Visual Interface (DVI). It is backward compatible with other interfaces, such as HDMI and DVI, through the use of either active or passive adapters.[2] It is the first display interface to rely on packetized data transmission, a form of digital communication found in technologies such as Ethernet, USB, and PCI Express. It permits the use of internal and external display connections. Unlike legacy standards that transmit a clock signal with each output, its protocol is based on small data packets known as micro packets, which can embed the clock signal in the data stream, allowing higher resolution using fewer pins.[3] The use of data packets also makes it extensible, meaning more features can be added over time without significant changes to the physical interface.[4] DisplayPort can be used to transmit audio and video simultaneously, although each can be transmitted without the other. The video signal path can range from six to sixteen bits per color channel, and the audio path can have up to eight channels of 24-bit, 192 kHz uncompressed PCM audio.[1] A bidirectional, half-duplex auxiliary channel carries device management and device control data for the Main Link, such as VESA EDID, MCCS, and DPMS standards. The interface is also capable of carrying bidirectional USB signals.[5] The interface uses a differential signal that is not compatible with DVI or HDMI.

|                                   |                     |                     |                     |                     |
|-----------------------------------|---------------------|---------------------|---------------------|---------------------|
| Resolution (pixels)               | 1080p (1920 × 1080) | 1440p (2560 × 1440) | 2160p (3840 × 2160) | 4320p (7680 × 4320) |
| Refresh rate (Hz)                 | 60                  | 60                  | 60                  | 60                  |
| Color depth (bits per pixel)      | 8                   | 8                   | 8                   | 8                   |
| Color space                       | sRGB                | sRGB                | sRGB                | sRGB                |
| Audio channels                    | 2                   | 2                   | 2                   | 2                   |
| Audio format                      | PCM                 | PCM                 | PCM                 | PCM                 |
| Audio sample rate (kHz)           | 48                  | 48                  | 48                  | 48                  |
| Audio bit depth (bits per sample) | 16                  | 16                  | 16                  | 16                  |
| Audio format                      | PCM                 | PCM                 | PCM                 | PCM                 |
| Audio sample rate (kHz)           | 48                  | 48                  | 48                  | 48                  |
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| Audio bit depth (bits per sample) | 16                  | 16                  | 16                  | 16                  |
| Audio format                      | PCM                 | PCM                 | PCM                 | PCM                 |
| Audio sample rate (kHz)           | 48                  | 48                  | 48                  | 48                  |
| Audio bit depth (bits per sample) | 16                  | 16                  | 16                  | 16                  |
| Audio format                      | PCM                 | PCM                 | PCM                 | PCM                 |
| Audio sample rate (kHz)           | 48                  | 48                  | 48                  | 48                  |
| Audio bit depth (bits per sample) | 16                  | 16                  | 16                  | 16                  |
| Audio format                      | PCM                 | PCM                 | PCM                 | PCM                 |
| Audio sample rate (kHz)           | 48                  | 48                  | 48                  | 48                  |
| Audio bit depth (bits per sample) | 16                  | 16                  | 16                  | 16                  |
| Audio format                      | PCM                 | PCM                 | PCM                 | PCM                 |
| Audio sample rate (kHz)           | 48                  | 48                  | 48                  | 48                  |
| Audio bit depth (bits per sample) | 16                  | 16                  | 16                  | 16                  |
| Audio format                      | PCM                 | PCM                 | PCM                 | PCM                 |
| Audio sample rate (kHz)           | 48                  | 48                  | 48                  | 48                  |
| Audio bit depth (bits per sample) | 16                  | 16                  | 16                  | 16                  |
| Audio format                      | PCM                 | PCM                 | PCM                 | PCM                 |
| Audio sample rate (kHz)           | 48                  | 48                  | 48                  | 48                  |
| Audio bit depth (bits per sample) | 16                  | 16                  | 16                  | 16                  |
| Audio format                      | PCM                 | PCM                 | PCM                 | PCM                 |
| Audio sample rate (kHz)           | 48                  | 48                  | 48                  | 48                  |
| Audio bit depth (bits per sample) | 16                  | 16                  | 16                  | 16                  |
| Audio format                      | PCM                 | PCM                 | PCM                 | PCM                 |
| Audio sample rate (kHz)           | 48                  | 48                  | 48                  | 48                  |
| Audio bit depth (bits per sample) | 16                  | 16                  | 16                  | 16                  |
| Audio format                      | PCM                 | PCM                 | PCM                 | PCM                 |
| Audio sample rate (kHz)           | 48                  | 48                  | 48                  | 48                  |
| Audio bit depth (bits per sample) | 16                  | 16                  | 16                  | 16                  |
| Audio format                      | PCM                 | PCM                 | PCM                 | PCM                 |
| Audio sample rate (kHz)           | 48                  | 48                  | 48                  | 48                  |
| Audio bit depth (bits per sample) | 16                  | 16                  | 16                  | 16                  |
| Audio format                      | PCM                 | PCM                 | PCM                 | PCM                 |
| Audio sample rate (kHz)           | 48                  | 48                  | 48                  | 48                  |
| Audio bit depth (bits per sample) | 16                  | 16                  | 16                  | 16                  |
| Audio format                      | PCM                 | PCM                 | PCM                 | PCM                 |
| Audio sample rate (kHz)           | 48                  | 48                  | 48                  | 48                  |
| Audio bit depth (bits per sample) | 16                  | 16                  | 16                  | 16                  |
| Audio format                      | PCM                 | PCM                 | PCM                 | PCM                 |
| Audio sample rate (kHz)           | 48                  | 48                  | 48                  | 48                  |
| Audio bit depth (bits per sample) | 16                  | 16                  | 16                  | 16                  |
| Audio format                      | PCM                 | PCM                 | PCM                 | PCM                 |
| Audio sample rate (kHz)           | 48                  | 48                  | 48                  | 48                  |
| Audio bit depth (bits per sample) | 16                  | 16                  | 16                  | 16                  |
| Audio format                      | PCM                 |                     |                     |                     |





Use the same color color, people with one dominant eye, where one eye is used more, are able to see the colors properly, previously negated by the separation of the two colors. Circular polarization has an advantage over linear polarization, in that the viewer does not need to have their head upright and aligned with the screen for the polarization to work properly. With linear polarization, turning the glasses sideways causes the filters to go out of alignment with the screen filters causing the image to fade and for each eye to see the opposite frame more often. For circular polarization, the polarizing effect works regardless of how the viewer's head is aligned with the screen such as tilted sideways, or even upside down. The left eye will still only see the image intended for it, and vice versa, without fading or crosstalk. Polarized light reflected from an ordinary motion picture screen typically loses most of its polarization.

So an expensive silver screen or aluminized screen with negligible polarization loss has to be used. All types of polarization will result in a darkening of the displayed image and poorer contrast compared to non-3D images. Light from lamps is normally emitted as a random collection of polarizations, while a polarization filter only passes a fraction of the light. As a result, the screen image is darker. This darkening can be compensated by increasing the brightness of the projector light source. If the initial polarization filter is inserted between the lamp and the image generation element, the light intensity striking the image element is not any higher than normal without the polarizing filter, and overall image contrast transmitted to the screen is not affected. Interference filter technology Main article: Anaglyph 3D § Interference filter systems Dolby 3D uses specific wavelengths of red, green, and blue for the right eye, and different wavelengths of red, green, and blue for the left eye. Eyeglasses which filter out the very specific wavelengths allow the wearer to see a 3D image. This technology eliminates the expensive silver screens required for polarized systems such as RealD, which is the most common 3D display system in theaters. It does, however, require much more expensive glasses than the polarized systems. It is also known as spectral comb filtering or wavelength multiplex visualization The recently introduced Omega 3D/Panavision 3D system also uses this technology, though with a wider spectrum and more "teeth" to the "comb" (5 for each eye in the Omega/Panavision system). The use of more spectral bands per eye eliminates the need to color process the image, required by the Dolby system.

Evenly dividing the visible spectrum between the eyes gives the viewer a more relaxed "feel" as the light energy and color balance is nearly 50-50. Like the Dolby system, the Omega system can be used with white or silver screens. But it can be used with either film or digital projectors, unlike the Dolby filters that are only used on a digital system with a color correcting processor provided by Dolby. The Omega/Panavision system also claims that their glasses are cheaper to manufacture than those used by Dolby.[10] In June 2012, the Omega 3D/Panavision 3D system was discontinued by DPVO Theatrical, who marketed it on behalf of Panavision, citing "challenging global economic and 3D market conditions".[citation needed] Although DPVO dissolved its business operations, Omega Optical continues promoting and selling 3D systems to non-theatrical markets.

Omega Optical's 3D system contains projection filters and 3D glasses. In addition to the passive stereoscopic 3D system, Omega Optical has produced enhanced anaglyph 3D glasses. The Omega's red/cyan anaglyph glasses use complex metal oxide thin film coatings and high quality annealed glass optics. Other Main article: Stereoscopic The Pulfrich effect is a psychophysical percept wherein lateral motion of an object in the field of view is interpreted by the visual cortex as having a depth component, due to a relative difference in signal timings between the two eyes.

Prismatic glasses make cross-viewing easier as well as over/under-viewing possible, examples include the KMQ viewer. Autostereoscopy Main article: Autostereoscopy The Nintendo 3DS uses parallax barrier autostereoscopy to display a 3D image. In this method, glasses are not necessary to see the stereoscopic image. Lenticular lens and parallax barrier technologies involve imposing two (or more) images on the same sheet, in narrow, alternating strips, and using a screen that either blocks one of the two images' strips (in the case of parallax barriers) or uses equally narrow lenses to bend the strips of image and make it appear to fill the entire image (in the case of lenticular prints). To produce the stereoscopic effect, the person must be positioned so that one eye sees one of the two images and the other sees the other. The optical principles of multiview auto-stereoscopy have been known for over a century.[11] Both images are projected onto a high-gain, corrugated screen which reflects light at acute angles. In order to see the stereoscopic image, the viewer must sit within a very narrow angle that is nearly perpendicular to the screen, limiting the size of the audience. Lenticular was used for theatrical presentation of numerous shorts in Russia from 1940 to 1948[12] and in 1946 for the feature-length film Robinson Kruzo[13] Though its use in theatrical presentations has been rather limited, lenticular has been widely used for a variety of novelty items and has even been used in amateur 3D photography.[14][15] Recent use includes the Fujifilm FinePix Real 3D with an autostereoscopic display that was released in 2009.

Other examples for this technology include autostereoscopic LCD displays on monitors, notebooks, TVs, mobile phones and gaming devices, such as the Nintendo 3DS. Volumetric display Main article: Volumetric display Volumetric 3D display Volumetric displays use some physical mechanism to display points of light within a volume. Such displays use voxels instead of pixels. Volumetric displays include multiplanar displays, which have multiple display planes stacked up, and rotating panel displays, where a rotating panel sweeps out a volume. Other technologies have been developed to project light dots in the air above a device. An infrared laser is focused on the destination in space, generating a small bubble of plasma which emits visible light. Light field / holographic display A light field display tries to recreate a "light field" on the surface of the display. In contrast to a 2D display which shows a distinct color on each pixel, a light field display shows a distinct color on each pixel for each direction that the light ray emits to. This way, eyes from different positions will see different pictures on the display, creating parallax and thus creating a sense of 3D. A light field display is like a glass window, people see 3D objects behind the glass, despite that all light rays they see come from (through) the glass. The light field in front of the display can be created in two ways: 1) by emitting different light rays in different directions at each point on the display. 2) by recreating a wavefront in front of the display. Displays using the first method are called ray-based or light field displays. Displays using the second method are called wavefront-based or holographic displays.

Wavefront-based displays work in the same way as holograms. Compared to ray-based displays, a wavefront-based display not only reconstructs the light field, but also reconstructs the curvature of the plane waves, and the phase differences of the waves in different directions.[16] Integral photography is one of the ray-based methods with full-parallax information.

However, there are also ray-based techniques developed with horizontal-parallax-only.[16] Holographic displays Main articles: Holographic display and Computer-generated holography Holographic display is a display technology that has the ability to provide all four eye mechanisms: binocular disparity, motion parallax, accommodation and convergence. The 3D objects can be viewed without wearing any special glasses and no visual fatigue will be caused to human eyes. In 2013, a Silicon valley Company LEIA Inc started manufacturing holographic displays well suited for mobile devices (watches, smartphones or tablets) using a multi-directional backlight and allowing a wide full-parallax angle view to see 3D content without the need of glasses.[17] Their first product was part of a mobile phone (Red Hydrogen One) and later on in their own Android tablet.[citation needed] Integral imaging Main article: Integral imaging Integral imaging is an autostereoscopic or multiscope 3D display, meaning that it displays a 3D image without the use of special glasses on the part of the viewer. It achieves this by placing an array of microlenses (similar to a lenticular lens) in front of the image, where each lens looks different depending on viewing angle. Thus rather than displaying a 2D image that looks the same from every direction, it reproduces a 3D light field, creating stereo images that exhibit parallax when the viewer moves. Compressive light field displays A new display technology called "compressive light field" is being developed. These prototype displays use layered LCD panels and compression algorithms at the time of display. Designs include dual[18] and multilayer[19][20][21] devices that are driven by algorithms such as computed tomography and Non-negative matrix factorization and non-negative tensor factorization. Problems Each of these display technologies can be seen to have limitations, whether the location of the viewer, cumbersome or unsightly equipment or great cost. The display of artifact-free 3D images remains difficult.[citation needed] See also Autostereogram Wiggle stereoscopy References ^ Holliman, Nicolas S.; Dodgson, Neil A.; Favalora, Gregg E.; Pockett, Lachlan (June 2011). "Three-Dimensional Displays: A Review and Applications Analysis" (PDF). IEEE Transactions on Broadcasting. 57 (2). ^ "New holographic waveguide augments reality". IOP Physics World. 2014. ^ "Holographic Near-Eye Displays for Virtual and Augmented Reality". Microsoft Research. 2017. ^ Martins, R; Shaoulov, V; Ha, Y; Rolland, J (2007). "A mobile head-worn projection display". Opt Express. 15 (22): 14530-8. Bibcode:2007OptExpr..1514530M. doi:10.1364/oe.15.014530. PMID 19550732. ^ Héríc, D; Sarkadi, T; Lucza, V; Kovács, V; Koppa, P (2014). "Investigation of a 3D head-mounted projection display using retro-reflective screen". Opt Express. 22 (15): 17823-9. Bibcode:2014OExpr..2217823H. doi:10.1364/oe.22.017823. PMID 25089403. ^ "Amazing 3D by Hal Morgan and Dan Symmes Little, Brown & Company (Canada) Limited, pp. 15-16. ^ ""The Chopper", article by Daniel L. Symmes".

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A boy studying with zSpace display, a type of 3D display A person wearing a virtual reality headset, a type of near-eye 3D display. A 3D display is a display device capable of conveying depth to the viewer. Many 3D displays are stereoscopic displays, which produce a basic 3D effect by means of stereopsis, but can cause eye strain and visual fatigue.

Newer 3D displays such as holographic and light field displays produce a more realistic 3D effect by combining stereopsis and accurate focal length for the displayed content. Newer 3D displays in this manner cause less visual fatigue than classical stereoscopic displays. As of 2021, the most common type of 3D display is a stereoscopic display, which is the type of display used in almost all virtual reality equipment. 3D displays can be near-eye displays like in VR headsets, or they can be in a device further away from the eyes like a 3D-enabled mobile device or 3D movie theater. The term "3D display" can also be used to refer to a volumetric display which may generate content that can be viewed from all angles. History The first 3D display was created by Sir Charles Wheatstone in 1832.[1] It was a stereoscopic display that had rudimentary ability for representing depth. Stereoscopic displays Main article: Stereoscopic Stereoscopic displays are commonly referred to as "stereo displays," "stereo 3D displays," "stereoscopic 3D displays," or sometimes errs in cously as just "3D displays." The basic technique of stereo displays is to present offset images that are displayed separately to the left and right eye. Both of these 2D offset images are then combined in the brain to give the perception of 3D depth. Although the term "3D" is ubiquitously used, it is important to note that the images that exhibit parallax when the viewer moves. Compressive light field displays A new display technology called "compressive light field" is being developed. These prototype displays use layered LCD panels and compression algorithms at the time of display. Designs include dual[18] and multilayer[19][20][21] devices that are driven by algorithms such as computed tomography and Non-negative matrix factorization and non-negative tensor factorization. Problems Each of these display technologies can be seen to have limitations, whether the location of the viewer, cumbersome or unsightly equipment or great cost. The display of artifact-free 3D images remains difficult.[citation needed] See also Autostereogram Wiggle stereoscopy References ^ Holliman, Nicolas S.; Dodgson, Neil A.; Favalora, Gregg E.; Pockett, Lachlan (June 2011). "Three-Dimensional Displays: A Review and Applications Analysis" (PDF). IEEE Transactions on Broadcasting. 57 (2). ^ "New holographic waveguide augments reality". IOP Physics World. 2014. ^ "Holographic Near-Eye Displays for Virtual and Augmented Reality". Microsoft Research. 2017. ^ Martins, R; Shaoulov, V; Ha, Y; Rolland, J (2007). "A mobile head-worn projection display". Opt Express. 15 (22): 14530-8. Bibcode:2007OExpr..1514530M. doi:10.1364/oe.15.014530. PMID 19550732. ^ Héríc, D; Sarkadi, T; Lucza, V; Kovács, V; Koppa, P (2014). "Investigation of a 3D head-mounted projection display using retro-reflective screen". Opt Express. 22 (15): 17823-9. Bibcode:2014OExpr..2217823H. doi:10.1364/oe.22.017823. PMID 25089403. ^ "Amazing 3D by Hal Morgan and Dan Symmes Little, Brown & Company (Canada) Limited, pp. 15-16. ^ ""The Chopper", article by Daniel L. Symmes".

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Such displays use voxels instead of pixels. Volumetric displays include multiplanar displays, which have multiple display planes stacked up, and rotating panel displays, where a rotating panel sweeps out a volume. Other technologies have been developed to project light dots in the air above a device. An infrared laser is focused on the destination in space, generating a small bubble of plasma which emits visible light. Light field / holographic display A light field display tries to recreate a "light field" on the surface of the display. In contrast to a 2D display which shows a distinct color on each pixel, a light field display shows a distinct color on each pixel for each direction that the light ray emits to. This way, eyes from different positions will see different pictures on the display, creating parallax and thus creating a sense of 3D. A light field display is like a glass window, people see 3D objects behind the glass, despite that all light rays they see come from (through) the glass. The light field in front of the display can be created in two ways: 1) by emitting different light rays in different directions at each point on the display. 2) by recreating a wavefront in front of the display. Displays using the first method are called ray-based or light field displays. Displays using the second method are called wavefront-based or holographic displays.

Wavefront-based displays work in the same way as holograms. Compared to ray-based displays, a wavefront-based display not only reconstructs the light field, but also reconstructs the curvature of the plane waves, and the phase differences of the waves in different directions.[16] Integral photography is one of the ray-based methods with full-parallax information. However, there are also ray-based techniques developed with horizontal-parallax-only.[16] Holographic displays Main articles: Holographic display and Computer-generated holography Holographic display is a display technology that has the ability to provide all four eye mechanisms: binocular disparity, motion parallax, accommodation and convergence. The 3D objects can be viewed without wearing any special glasses and no visual fatigue will be caused to human eyes. In 2013, a Silicon valley Company LEIA Inc started manufacturing holographic displays well suited for mobile devices (watches, smartphones or tablets) using a multi-directional backlight and allowing a wide full-parallax angle view to see 3D content without the need of glasses.[17] Their first product was part of a mobile phone (Red Hydrogen One) and later on in their own Android tablet.[citation needed] Integral imaging Main article: Integral imaging Integral imaging is an autostereoscopic or multiscope 3D display, meaning that it displays a 3D image without the use of special glasses on the part of the viewer. It achieves this by placing an array of microlenses (similar to a lenticular lens) in front of the image, where each lens looks different depending on viewing angle. Thus rather than displaying a 2D image that looks the same from every direction, it reproduces a 3D light field, creating stereo images that exhibit parallax when the viewer moves. Compressive light field displays A new display technology called "compressive light field" is being developed. These prototype displays use layered LCD panels and compression algorithms at the time of display. Designs include dual[18] and multilayer[19][20][21] devices that are driven by algorithms such as computed tomography and Non-negative matrix factorization and non-negative tensor factorization. Problems Each of these display technologies can be seen to have limitations, whether the location of the viewer, cumbersome or unsightly equipment or great cost. The display of artifact-free 3D images remains difficult.[citation needed] See also Autostereogram Wiggle stereoscopy References ^ Holliman, Nicolas S.; Dodgson, Neil A.; Favalora, Gregg E.; Pockett, Lachlan (June 2011). "Three-Dimensional Displays: A Review and Applications Analysis" (PDF). IEEE Transactions on Broadcasting. 57 (2). ^ "New holographic waveguide augments reality". IOP Physics World. 2014. ^ "Holographic Near-Eye Displays for Virtual and Augmented Reality". Microsoft Research. 2017. ^ Martins, R; Shaoulov, V; Ha, Y; Rolland, J (2007). "A mobile head-worn projection display". Opt Express. 15 (22): 14530-8. Bibcode:2007OExpr..1514530M. doi:10.1364/oe.15.014530. PMID 19550732. ^ Héríc, D; Sarkadi, T; Lucza, V; Kovács, V; Koppa, P (2014). "Investigation of a 3D head-mounted projection display using retro-reflective screen". Opt Express. 22 (15): 17823-9. Bibcode:2014OExpr..2217823H. doi:10.1364/oe.22.017823. PMID 25089403. ^ "Amazing 3D by Hal Morgan and Dan Symmes Little, Brown & Company (Canada) Limited, pp. 15-16. ^ ""The Chopper", article by Daniel L. Symmes".

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