

Exhibit I-12: Invalidity Based on the HTC Vive Systems (“HTC Vive Systems”)

U.S. Patent No. 11,290,836

Claims 8 and 10 (the “Asserted Claims”) of the ’836 Patent are anticipated under 35 U.S.C. § 102 and/or obvious under 35 U.S.C. § 103 in view of the Oculus Rift CV1 System¹ (“Oculus Rift CV1 System”), as embodied in the Oculus Rift CV1 products themselves, and other prior art references that describe them. To the extent Plaintiff argues that the Oculus Rift CV1 System does not disclose any limitation, either expressly, implicitly, and/or by inherency, a person of ordinary skill in the art would have determined that the limitation would have been obvious in light of the Oculus Rift CV1 System alone or in combination with applicant admitted prior art, the knowledge of one of ordinary skill in the art, or any one or more of the references identified in Defendants’ invalidity contentions for at least the reasons stated in the cover pleading for Defendants’ invalidity contentions and/or in the accompanying claim charts.

The contentions provided below address the Asserted Claims that Plaintiff identified in its infringement contentions. Defendants reserve the right to supplement or modify these contentions in accordance with and to address orders of the Court (e.g., any claim construction

¹ The Oculus Rift CV1 System referred to herein includes, but is not limited to, the various physical prototypes (e.g., DK1, DK2, Crescent Bay, the engineering prototype of the Oculus Rift CV1 headset presented at E3 in June 2015, Half Moon), commercial products, and systems created and publicly presented by Oculus prior to any date to which the ’509 Patent can claim priority. See Section II of Defendants’ Invalidity Contentions. The Oculus Rift CV1 System was announced on May 5, 2015, and publicly demonstrated (including with the Oculus Touch controllers) at E3 in June 2015. See VRCompare, “Oculus Rift” <https://vr-compare.com/headset/oculusrift/>; Adam Savage’s Tested, “Oculus Rift CV1 + Oculus Touch Controller Hands-On + Impressions!” (June 18, 2015), <https://www.youtube.com/watch?v=asduqdRizqs>; PCGamer, “The Oculus Touch Is an Intuitive, Exciting VR Controller” (June 17, 2015), <https://www.pcgamer.com/the-oculus-touch-is-an-intuitive-exciting-vr-controller/>. The Oculus Rift CV1 System, including the Oculus Rift CV1 headset, sensor (or base station), remote, Xbox One wireless controller, and the necessary connection cords, began shipping to consumers on March 27, 2016. See Meta Blog, “Oculus Rift Pre-Orders Now Open, First Shipments March 28” (Jan. 6, 2016), <https://www.meta.com/blog/quest/oculus-rift-pre-orders-now-open-first-shipments-march-28/>; UploadVR, “Oculus Rift Review: The Age of Virtual Reality Begins Here” (Mar. 28, 2016), <https://www.uploadvr.com/oculus-rift-cv1-review/>. The Oculus Touch controllers were available for preorder on October 10, 2016, and began shipping to consumers on December 6, 2016. See Meta Blog, “Oculus Touch Pre-Orders Are Now Live” (Oct. 10, 2016), <https://www.meta.com/blog/quest/oculus-touch-pre-orders-are-now-live/>; The Verge, “Oculus Touch controllers are now available for preorder for \$199” (Oct. 10, 2016), <https://www.theverge.com/2016/10/10/13224702/preorders-open-oculus-rift-touch-controllers>. All disclosures describing the functionalities of the prototypes (e.g., Crescent Bay, the engineering prototype of the Oculus Rift CV1 headset presented at E3 in June 2015, Half Moon) equally apply to the functionalities of the Oculus Rift CV1 System, and are therefore incorporated by reference.

order(s)), Local Rules, other applicable rules, and/or in response to any supplementation, amendment, or modification of Plaintiff's infringement contentions.

The following disclosures are for prior art purposes only. The following chart may include positions in the alternative and does not constitute any concession by Defendants for purposes of infringement. Defendants' contentions herein are not, and should in no way be seen as, admissions or adoptions regarding any particular claim scope or construction or alleged infringement, either literally or under the doctrine of equivalents. Defendants do not agree with Plaintiff's application of the claims, or that the claims satisfy other statutory requirements, e.g., under 35 U.S.C. § 112. Furthermore, to the extent any Asserted Claim is subject to 35 U.S.C. § 112(6), Defendants' invalidity contentions are in no way an admission that the '184 Patent specification sufficiently discloses or describes corresponding structure for performing the claimed function. Defendants' contentions also are based, at least in part, on Plaintiff's Infringement Contentions to date and Plaintiff's overly broad interpretation and application of the Asserted Claims.

The citations to portions of any reference in this chart are exemplary only and are not exhaustive of the disclosures of the limitations in the art. Furthermore, citations to any figure, table, chart, component, or embodiment are meant to encompass the language describing the respective figure, table, chart, component, or embodiment and vice versa. Defendants will rely on the entirety of the references cited in this chart to show that the Asserted Claims are invalid, as will Defendants' experts. Defendants also reserve the right to rely on additional citations or sources of evidence that may be or become applicable during discovery as this case progresses, e.g., through third-party discovery.

Claim	The Oculus Rift CV1 System Exemplary Disclosures
CLAIM 8	
8[pre]. An electronic device, comprising:	To the extent the preamble is limiting, the Oculus Rift CV1 System discloses and/or renders obvious, alone or in combination with other prior art, an "electronic device" as embodied in the product itself and as reflected in other prior art references that describe it. For example: As shown in the figure below, the Oculus Rift CV1 System² includes a computer, which includes, for example, a 3rd Gen Intel Core i5-3470 Processor (Quad Core, 3.20GHz Turbo, 6MB, w/ HD2500 Graphics)

² META-8KHZ_00047852.

Claim	The Oculus Rift CV1 System Exemplary Disclosures
	CPU processor and memory; the headset itself; base station(s); and hand-held controllers, such as the Oculus Touch controllers  “The hardware itself connects to the back of the computer using two USB 3.0 ports (one for the headset and one for the tracking sensor) and a single HDMI, which needs to be connected directly into the HDMI port on the graphics card (you can’t use an adapter). Once the software is installed and the headset is plugged into the computer, you will need to set up an Oculus account. This will allow you to make purchases and find friends within the Oculus platform.”

Claim	The Oculus Rift CV1 System Exemplary Disclosures
	 <i>See UploadVR, “Oculus Rift Review: The Age of Virtual Reality Begins Here” (Mar. 28, 2016).</i>

Claim	The Oculus Rift CV1 System Exemplary Disclosures
	 “All Rift pre-orders include access to EVE: Valkyrie through the Founder’s Pack, which will include exclusive in-game content, founder status in Valkyrie, and much more. Details about everything included in the EVE: Valkyrie Founder’s Pack will be revealed soon. ... Oculus Ready PCs If you need a new PC to power your Rift, Oculus Ready PCs will be certified to meet our recommended system specification and have been tested by Oculus to ensure they deliver a great experience with Rift.” <i>See Meta Blog, “Oculus Rift Pre-Orders Now Open, First Shipments March 28” (Jan. 6, 2016).</i>
8[a]. a display that displays an image that occurs within a near-field distance	The Oculus Rift CV1 System discloses and/or renders obvious, alone or in combination with other prior art, “a display that displays an image that occurs within a near-field distance from a head of a user” as embodied in the product itself and as reflected in other prior art references that describe it. For example:

Claim	The Oculus Rift CV1 System Exemplary Disclosures
from a head of a user; and	<i>See Adam Savage's Tested, "Oculus Rift CV1 + Oculus Touch Controller Hands-On + Impressions!" (June 18, 2015).</i> The Oculus Rift CV1 System has a display that displays images that occur within near-field distances from the head of a user. The headset is worn on the head and has two lenses that present images to the user. The lenses are inches away from the user's eyes, less than 1 meter away, which is how the '836 patent defines a "near-field distance." Furthermore, images presented on those lenses, inches from a user's eyes, are placed at a focal depth that allows the user's eyes to focus on the image.

Claim	The Oculus Rift CV1 System Exemplary Disclosures
	 <i>See Adam Savage's Tested, "Oculus Rift CV1 + Oculus Touch Controller Hands-On + Impressions!" (June 18, 2015).</i>

Claim	The Oculus Rift CV1 System Exemplary Disclosures
	 A photograph showing the internal components of an Oculus Rift CV1 headset. The headset is held open by two hands, revealing the two large, clear, spherical lenses. Between the lenses, a circuit board with various electronic components is visible. The headset's frame is black plastic.

Claim	The Oculus Rift CV1 System Exemplary Disclosures
	 <i>See UploadVR, “Hands On With the Oculus Rift CV1” (June 16, 2015).</i>

Claim	The Oculus Rift CV1 System Exemplary Disclosures
	“The Rift uses a pair of custom hybrid fresnel lenses that give it a fairly wide field of view. Oculus doesn’t specify exactly what that FOV is, but they have gone on record in the past to say that it is larger than the DK2 – which had a FOV of 100 degrees.” <i>See UploadVR, “Oculus Rift Review: The Age of Virtual Reality Begins Here” (Mar. 28, 2016).</i>

Claim	The Oculus Rift CV1 System Exemplary Disclosures
	 <i>See iFixIt, “Oculus Rift CV1 Teardown” (Mar. 30, 2016).</i>

Examples of virtual images the Oculus Rift CV1 System displays include virtual images presented in gaming applications. For example, the figures below shows the virtual images in the *Showdown* demo with an image of, for example, an alien robot:



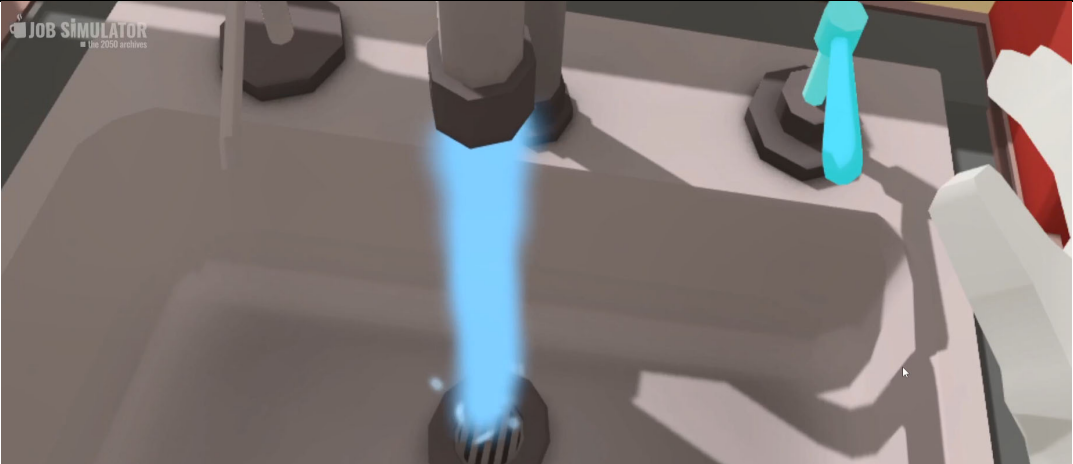
See Video of Video of Oculus Rift CV1 - Showdown.³ Showdown was compatible with the Oculus Rift CV1 system. See Unreal Engine, “Showdown Cinematic VR Experience Released for Free!” (Sept. 2, 2015)⁴; Unreal Engine, “Showdown Cinematic VR Demo by Epic Games” (Sept. 2, 2015)⁵.

Claim	The Oculus Rift CV1 System Exemplary Disclosures
	Other games, like Job Simulator and EVE: Valkyrie, also display virtual images, as shown in the figures below. 

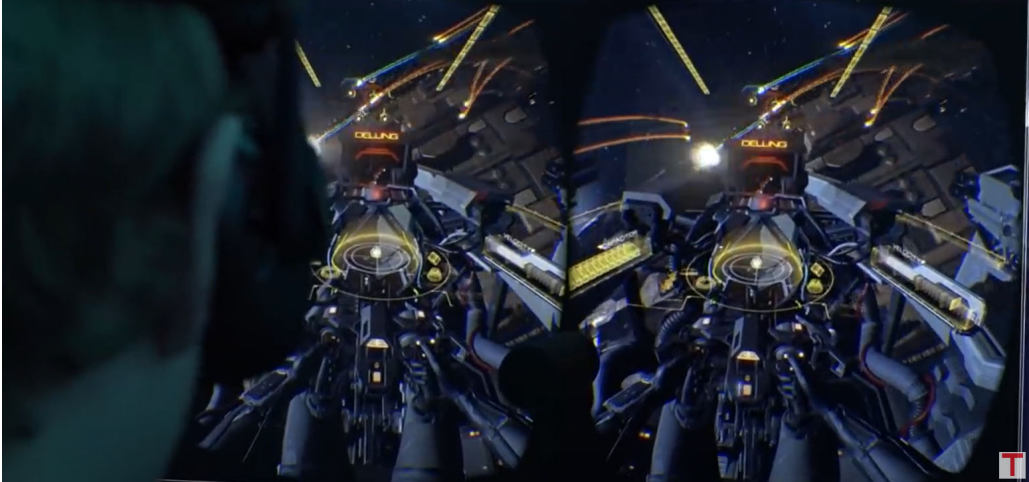
³ META-8KHZ_00047851.

⁴ <https://www.unrealengine.com/en-US/blog/showdown-cinematic-vr-experience-released-for-free>.

⁵ <https://www.youtube.com/watch?v=1O5knLWY8zA>.

Claim	The Oculus Rift CV1 System Exemplary Disclosures
	 <i>See Video of Oculus Rift CV1 – Job Simulator⁶</i>

⁶ META-8KHZ_00047848.

Claim	The Oculus Rift CV1 System Exemplary Disclosures
	 <i>See Adam Savage's Tested, "EVE: Valkyrie on Oculus Rift VR Playtest!" (Dec. 10, 2015).⁷</i> As the above images demonstrate, the Oculus Rift CV1 System displayed virtual images at near-field distances from the head of a user. For example, the robots in the images above are both presented through lenses that are inches away from the user and can be perceived by the user to be less than 1 m away (e.g., when the robot comes up close to the user in the VR environment).
8[b]. one or more processors that process sound for the image	The Oculus Rift CV1 System discloses and/or renders obvious, alone or in combination with other prior art, "one or more processors that process sound for the image" as embodied in the product itself and as reflected in other prior art references that describe it. For example:

⁷ <https://www.youtube.com/watch?v=UmEJmRxfz80>.

Claim	The Oculus Rift CV1 System Exemplary Disclosures
	The Oculus Rift CV1 System has “one or more processors that process sound” since the system includes a computer which includes, for example, a 3rd Gen Intel Core i5-3470 Processor (Quad Core, 3.20GHz Turbo, 6MB, w/ HD2500 Graphics) CPU, as shown in the figure below.  That Intel Core i5-3470 processor processes sound for images. The image below shows earphones, for playing binaural sound, provided as part of the Oculus Rift CV1 headset. <i>See UploadVR, “Oculus Rift Review: The Age of Virtual Reality Begins Here” (Mar. 28, 2016).</i>

Claim	The Oculus Rift CV1 System Exemplary Disclosures
	“Users who wish to use their own headphones for a higher quality experience can remove the built in ones from the headset with relative ease – however there is not a headphone jack built into the headset, so you will have to either use wireless headphones or run an Aux cord from your computer.”  The sounds heard through such headphones for applications and games running on the Oculus Rift CV1 System—which are processed by the exemplary Intel Core i5-3470 processor—are “sounds for the image[s]” displayed in those applications and games. <i>See Tom’s Hardware</i>, “Hands On With Oculus Rift Crescent

Claim	The Oculus Rift CV1 System Exemplary Disclosures
	Bay: Finally Achieving Presence” (Sept. 23, 2014)⁸ (discussing an early implementation of 3D audio on Oculus’s Crescent Bay) (““The directional audio headphones were a new addition too. Directional audio is now part of the Oculus SDK, and while users can choose to use their own audio headphones, the goal is for the Oculus Rift to be a complete solution with a standardized experience delivery.”). “The core features: 360-degree tracking (there are LEDs on the back of the headset now), a quicker refresh rate, and optional integrated audio (you can move the small attached earbuds out of the way to use your own headphones) along with 360 VR audio software powered by RealSpace 3D’s audio system. <i>See</i> PCWorld, “New Oculus Rift ‘Crescent Bay’ Prototype Packs Integrated Audio and 360-Degree Tracking” (Sept. 20, 2014)⁹ (discussing an early implementation of 3D audio on Oculus’s Crescent Bay). “For Crescent Bay, Oculus put together a series of short demos that lasted about five minutes I’d estimate. All of these used positional audio, so as you turned or leaned in, you got a clear sense of the sounds moving around you. This isn’t anything really new, as we’ve had audio HRTF (Head Related Transfer Functions) doing positional audio for a while now, but combined with the goggles and stereoscopic 3D it’s very immersive. Oculus has licensed Visisonics’ 3D audio libraries, though they’re doing a lot of customizations to make things work with the Oculus Rift obviously” <i>See</i> AnandTech, “Oculus Demos Crescent Bay and 3D Audio” (Jan. 13, 2015)¹⁰ (discussing an early implementation of 3D audio on Oculus’s Crescent Bay). Moreover, because the system is tracked, and the location of user’s head relative to an image in an application or game is known, sound can be processed for a particular image. For example, a video showing “Showdown” encounters different explosions, people shouting, and car noises. As the user moves through

⁸ <https://www.tomshardware.com/news/oculus-vr-oculus-rift-crescent-bay,27741.html>.

⁹ <https://www.pcworld.com/article/435380/oculus-announces-tk.html>.

¹⁰ <https://www.anandtech.com/show/8876/oculus-demos-crescent-bay-and-vr-audio>.

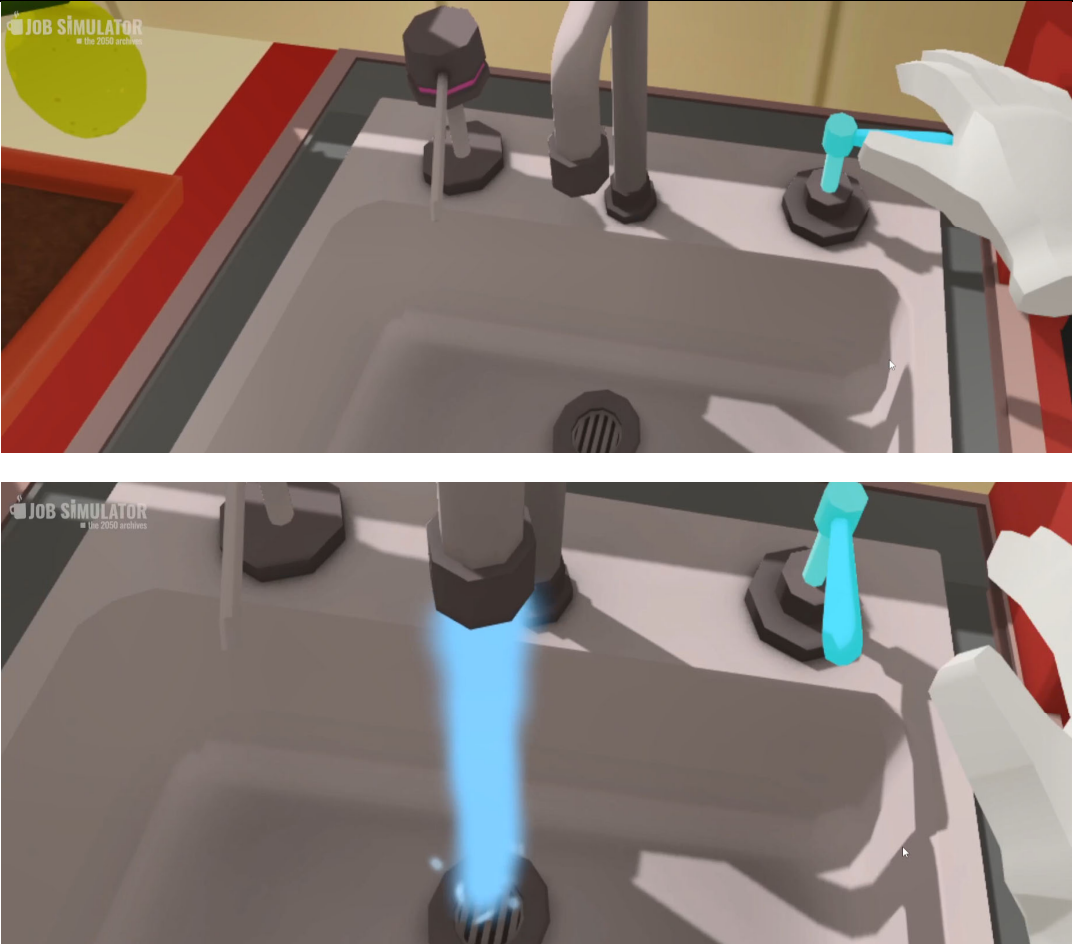
Claim	The Oculus Rift CV1 System Exemplary Disclosures
	the scene, the different sounds in the virtual environment originate from the location of the virtual objects (e.g., whizzing explosives, people shouting). 

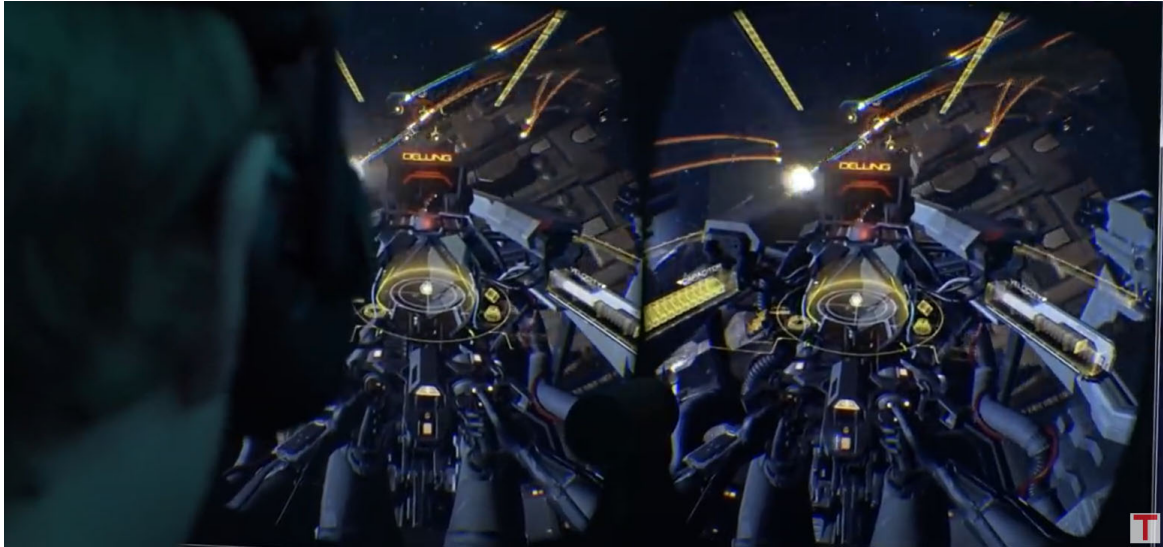
Claim	The Oculus Rift CV1 System Exemplary Disclosures
	<i>See Video of Oculus Rift CV1 – Showdown.</i>¹¹ Similarly, in other games like Job Simulator and EVE: Valkyrie, sounds change based on the location of the user and virtual images. “I’m here with Alex, of course, from Owlchemy Labs because of Job Simulator. And you guys are here showing off your game with Oculus Touch.” “What you’re playing here is the rearranged version which has everything completely except accessible on the Touch controllers, with no tracking loss or any problems like that. It’s been working great now.” “Really, it’s six degrees of freedom motion that you can reach anywhere and do anything and have a single trigger ... You’re pulling a cork out of a wine bottle, which means that one hand is holding it and then you reach the other hand right up next to it ... You’re pouring drink from one drink to the other.”

¹¹ META-8KHZ_00047851.

Claim	The Oculus Rift CV1 System Exemplary Disclosures
	 <i>See Adam Savage's Tested, "Oculus Rift's Virtual Reality Consumer Launch Lineup" (Mar. 16, 2016)¹²</i>

¹² <https://www.youtube.com/watch?v=ID4LF-9ou6E>.

Claim	The Oculus Rift CV1 System Exemplary Disclosures
	

Claim	The Oculus Rift CV1 System Exemplary Disclosures
	<i>See Video of Oculus Rift CV1 – Job Simulator</i>¹³ (showing the user interacting with virtual objects where sound localizes).  <i>See Adam Savage’s Tested, “EVE: Valkyrie on Oculus Rift VR Playtest!”</i> (Dec. 10, 2015)¹⁴ (showing the user interacting with virtual objects where sound localizes).

¹³ META-8KHZ_00047848.

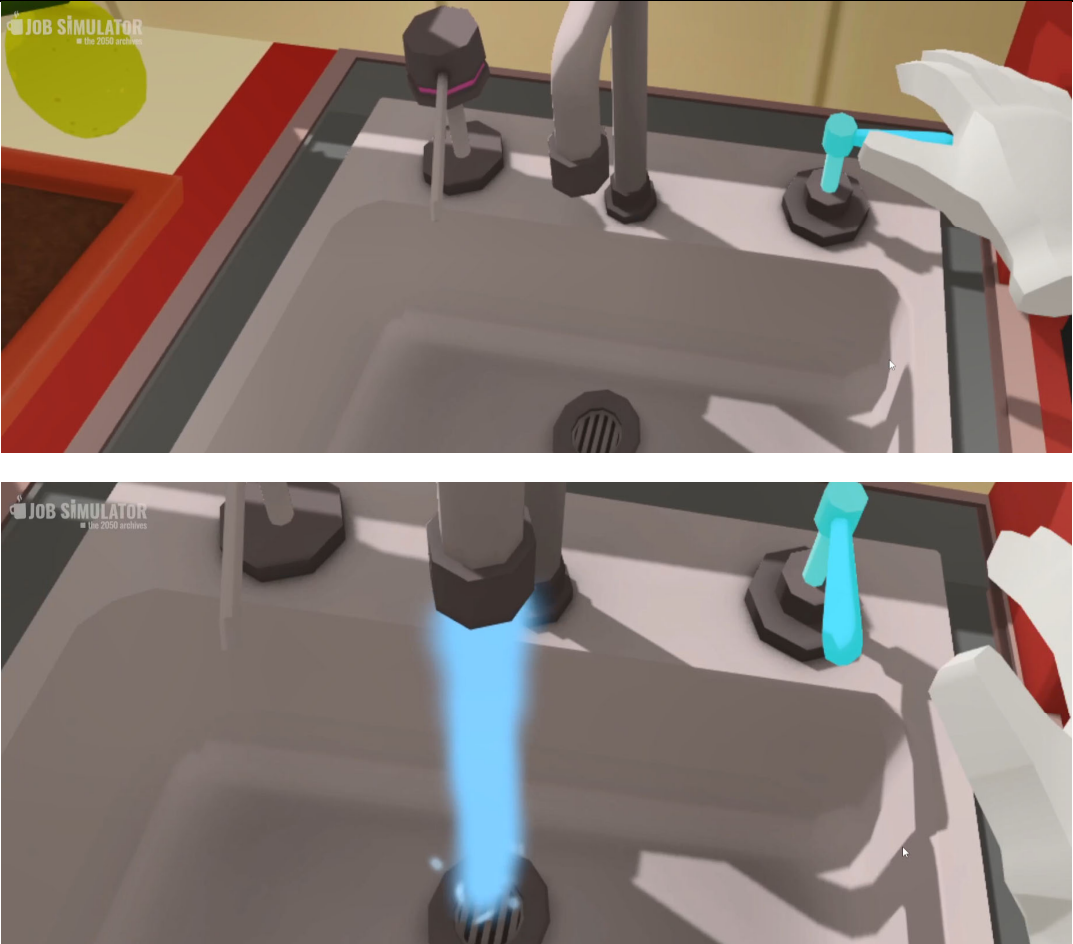
¹⁴ <https://www.youtube.com/watch?v=UmEJmRxfz80>.

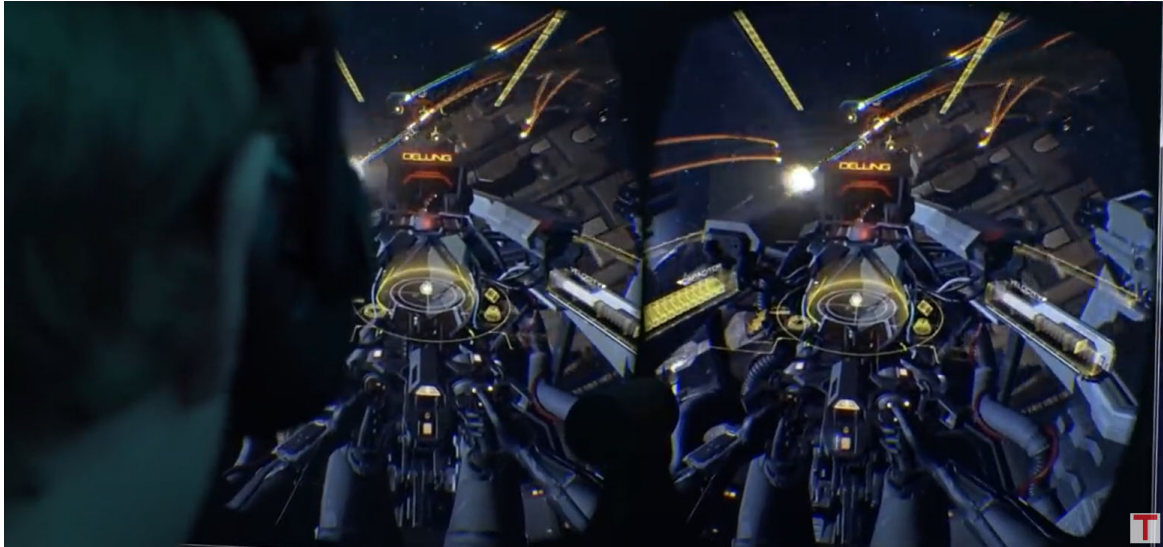
Claim	The Oculus Rift CV1 System Exemplary Disclosures
	 See UploadVR, “‘EVE: Valkyrie’ Review: Space Ace” (Mar. 28, 2016)¹⁵ (similar); <i>see also</i> IGN, “List of Games Compatible with Oculus Rift” (Mar. 28, 2016)¹⁶ (identifying list of Oculus Rift CV1 launch titles); UploadVR, “Oculus Rift Review: The Age of Virtual Reality Begins Here” (Mar. 28, 2016) (“Everyone who receives the Rift either through pre-order or Kickstarter backing will get a number of pieces of content to play with as soon as they create their account including some two of the best launch titles: Lucky’s Tale and EVE: Valkyrie, as well as a new title from Oculus called Farlands, which will receive daily updates.”).

¹⁵ <https://www.uploadvr.com/eve-valkyrie-review-space-ace-rift-launch/>.

¹⁶ https://www.ign.com/wikis/oculus-rift/List_of_Games_Compatible_with_Oculus_Rift.

Claim	The Oculus Rift CV1 System Exemplary Disclosures
8[c] to generate binaural sound that has a sound localization point (SLP) with a coordinate location that occurs at a far-field distance located behind the image and along a line-of-sight from the user to the image while the display displays the image to the user at the near-field distance,	The Oculus Rift CV1 System discloses and/or renders obvious, alone or in combination with other prior art “generat[ing] binaural sound that has a sound localization point (SLP) with a coordinate location that occurs at a far-field distance located behind the image and along a line-of-sight from the user to the image while the display displays the image to the user at the near-field distance” as embodied in the product itself and as reflected in other prior art references that describe it. For example: In the Oculus Rift CV1 System, sounds are generated by the application that is being used by the user. The application may also choose to use its own audio spatialization engine and may read the headset position to perform its own spatialization. For example, various applications that worked on the Oculus Rift CV1 system, including Epic Games’ <i>Showdown</i>, which used the Unreal Engine 4 and audio spatialization to create binaural sounds using HRFTs. And as with <i>Showdown</i>, <i>EVE: Valkyrie</i> also incorporated Unreal Engine 4, and so was capable of generating binaural sound using HRTFs. Moreover, as the images below from <i>Job Simulator</i>, <i>EVE: Valkyrie</i> and <i>Showdown</i> show, in applications and games, users of the Oculus Rift CV1 System could see virtual objects at near- and far-field distances, and those virtual objects generated sounds at near- and far-field distances. The sounds also were (and could obviously be) along a line of sight from the user to images, including images being displayed with the headset and its lenses, at near-field distances from a user’s head. Further, any sound presented at a far-field location (i.e., at a “sound localization point (SLP) with a coordinate location that occurs at a far-field distance”) would be (or could obviously be) located behind the image associated with that sound when the image is displayed less than 1 meter away from the user, e.g., within inches of the user’s eyes on the headset’s lenses and/or when virtual objects (such as the robot in <i>Showdown</i> or the sink in <i>Job Simulator</i>) are perceived by the user to be close.

Claim	The Oculus Rift CV1 System Exemplary Disclosures
	

Claim	The Oculus Rift CV1 System Exemplary Disclosures
	<i>See Video of Oculus Rift CV1 – Job Simulator</i>¹⁷ (showing the user interacting with virtual objects where sound localizes).  <i>See Adam Savage’s Tested, “EVE: Valkyrie on Oculus Rift VR Playtest!”</i> (Dec. 10, 2015)¹⁸

¹⁷ META-8KHZ_00047848.

¹⁸ <https://www.youtube.com/watch?v=UmEJmRxfz80>.

Claim	The Oculus Rift CV1 System Exemplary Disclosures
	 <i>See Video of Oculus Rift CV1 – Showdown.</i>¹⁹

¹⁹ META-8KHZ_00047851.

Claim	The Oculus Rift CV1 System Exemplary Disclosures
	To the extent Plaintiff argues that the Oculus Rift CV1 System does not disclose this limitation, either expressly, implicitly, and/or by inherency, a person of ordinary skill in the art would have determined that the limitation would have been obvious in light of the Oculus Rift CV1 System alone or in combination with any applicant admitted prior art, the knowledge of one of ordinary skill in the art, or any one or more of the references identified in Defendants’ Invalidity Contentions under Sections IV.J.8 and IV.J.6 for at least the reasons stated in Defendants’ Invalidity Contentions cover pleading. <i>See, e.g., Algazi 2011</i> at 35 (“The HRTF is defined as the ratio of the Fourier transform of the sound pressure developed at the ear to the Fourier transform of the sound pressure developed at the location of the center of the listener’s head with the listener absent. This frequency-domain definition has the advantage that the resulting HRTF is essentially independent of range when the source is in the far field. Most HRTF measurements are made under these conditions. The far-field range dependence is easily obtained merely by adding the propagation delay and the inverse range dependence. The inverse Fourier transform of the HRTF is the head-related impulse response (HRIR). If h_1 is the head-related impulse response for a distant source and c is the speed of sound, then the anechoic pressure response to an impulsive velocity source at a distance r is proportional to $h_1 t_2 r/c^2$. The situation is more complicated when the source has a complicated radiation pattern or is distributed or is close to the head [16], and we limit our discussion to an isotropic point source in the far-field.”); <i>Begault 2000</i> at 12, 112 (“The 3-D sound system designer in most cases will want to obtain a library of HRTF measurements, from which particular sets can be selected on the basis of either user preference or behavioral data. Several corporate and university research projects are underway where HRTF measurements are collected and subsequently utilized for digital filtering. Someday, a collection may be available on a CD-ROM; already, some HRTFs are available over computer networks (see Chapter 6).”), 118 (“A review of the literature shows that KEMAR’s HRTFs have been used many times in both 3-D sound applications and localization studies (e.g., Kendall, Martens, and Wilde, 1990).”), 139, 140, 170 (“The AL-204 (see Figure 5.9), was an early four-channel DSP-based convolution device that used HRTFs based on measurements of the KEMAR mannequin head (Figure 4.25) made at Northwestern University (cf. Kendall, Martens, and Wilde, 1990).”); <i>Zhou</i> at 1044-45 (“An alternative way to generate 3D sound is to use open source software development kits (SDKs), which have already incorporated the general HRTFs database and simple model of environment to generate 3D sound. The minimum requirement of these SDKs to generate 3D sound is to update the relative position of the virtual sound source to the head coordinate system..”), <i>id.</i> at 1046 (“For easy implementation of 3D sound generation, several open source SDKs, have been developed such as OpenAL (Loki Entertainment Software) and FMOD (Firelight Technologies). These use the general HRTFs database and modeling environment in a relative simple manner. However, as mentioned in Section

Claim	The Oculus Rift CV1 System Exemplary Disclosures
	1, for AR systems 3D sound does not play a significant role to tell the depth (or the distance of the frontal sound sources) because most of actual AR spaces are relatively of small size (for example small offices).”); Algazi 2001 at 99 (“Head-related transfer functions (HRTFs) capture the sound localization cues created by the scattering of incident sound waves by the body, and play a central role in spatial audio systems. Most HRTF-based commercial systems convolve the input signal with a single, “standard” head-related impulse response (HRIR), and several studies have employed the public-domain dataset for the KEMAR mannequin [1]. ... The CIPIC Interface Laboratory at U.C. Davis has measured HRTFs at high spatial resolution for more than 90 subjects. Release 1.0 — a public-domain subset for 45 subjects (including KEMAR with large and with small pinnae) — is available by downloading from our web site (http:// interface.cipic.ucdavis.edu). In addition to including impulse responses for 1250 directions for each ear of each subject, the database includes a set of anthropometric measurements that can be used for scaling studies. This paper describes the content of the database, and briefly describes the characteristics of the data. ... All HRTFs were measured with the subject seated at the center of a 1-m radius hoop whose axis was aligned with the subject’s interaural axis. The position of the subject’s head was not constrained, but the subject could monitor his or her head position [7]. ... Sound source location was specified by the azimuth angle ; and elevation angle < in interaural-polar coordinates.”);100, 102 (“We hope that public availability of the CIPIC HRTF database, augmented with anthropometric measurements, will facilitate further research in the understanding, modeling, and use of individualized HRTFs.”); Rombloom at Abstract (“It is difficult to present near-field virtual audio displays using available HRTF filters, as most existing databases are measured at a single distance in the far-field of the listener’s head. Measuring near-field data is possible, but would quickly become tiresome due to the large number of distances required to simulate sources moving close to the head. For applications requiring a convincing near-field virtual audio display, one could compensate the far-field HRTF filters with a scheme based on 1/r spreading roll off.”); <i>id.</i> at 1-2 (“When binaural synthesis is chosen to simulate 3D sound sources over headphones, the Head-Related Transfer Functions (HRTF) used have most often been measured at a single distance in the far-field of the listener. Unfortunately, including a variety of near-field distances would substantially increase the required number of physical measurements. To avoid this cumbersome procedure, it is possible to compensate the existing data using the well known law of ‘1/r spreading roll off’ [5], effectively turning up the volume as you approach the head. ... In this paper, we investigate two complementary methods for simulating near-field sources using common far-field HRTFs.”); 3, 4-5 (“In 1999, Brungart showed a systematic mapping between nearfield and far-field HRTFs that depends upon the distance and orientation of a source

Claim	The Oculus Rift CV1 System Exemplary Disclosures
	relative to the head.”); Brungart at Abstract (“Researchers have long recognized that the binaural difference cues that dominate auditory localization are independent of distance beyond 1 m but change systematically with distance when source the approaches within 1 m of the listener’s head. More recent research has shown that listeners are able to use these binaural cues to determine the distances of nearby sound sources. However, technical challenges in the collection and processing of near-field Head-Related Transfer Functions (HRTFs) have thus far prevented the construction of a near-field audio display. This paper summarizes the current state of research in the localization of nearby sound sources, and outlines the technical challenges involved in the creation of a near-field virtual audio display.”), 1 (“However, the current generation of virtual audio displays cannot generate realistic virtual sounds in the “near field” within 1 m of the head.”), 2 (“Fig. 1. Head-Related Transfer Functions (HRTFs) for a sound source directly to the left of the listener (90) measured at three distances (1.0 m, 0.25 m, and 0.12 m) from the center of the head. The HRTFs were measured with a Knowles Electronics Manikin for Acoustic Research (KEMAR) and an acoustic point source, and have been normalized by the free-field sound pressure at the center of the head to eliminate the overall effects of distance (Brungart and Rabinowitz, 1999).”); 3 (“These studies have shown that, when the source is within 1 m of the listener’s head, the HRTF changes substantially with distance.”); Gardner 1994 at Abstract (“An extensive set of head-related transfer function (HRTF) measurements of a KEMAR dummy head microphone has recently been completed. The measurements consist of the left and right ear impulse response from a Realistic Optimus Pro 7 loudspeaker mounted 1.4 meters from the KEMAR. This data is being made available to the research community on the Internet via anonymous FTP and the World Wide Web.”); Finnegan at Abstract (“Our results have a significant and intriguing implication for designers of VEs: an incongruent audiovisual display, i.e. where the audio and visual information is intentionally misaligned, may lead to better spatial perception of a virtual scene.”), 3 (“Perceptual binding (i.e. the audio and visual components of the target being perceived together as a whole object) was maintained despite the incongruence between the visual and auditory stimuli.”), 5-7; Andreopoulou at 2; Gupta at 169-172.
8[d] wherein the one or more processors include a digital signal processor (DSP)	The Oculus Rift CV1 System discloses and/or renders obvious, alone or in combination with other prior art “wherein the one or more processors include a digital signal processor (DSP)” as embodied in the product itself and as reflected in other prior art references that describe it. For example: The Oculus Rift CV1 System requires a computer to function. The computer performs the processing required to display an image and produce a sound. A compatible computer can have a variety of processors

Claim	The Oculus Rift CV1 System Exemplary Disclosures
	to perform this processing, including CPUs, GPUs, and DSPs. Both integrated and external DSPs for processing audio were known, available, and would have been obvious to use before the earliest asserted priority date for use with computers like those used with the Oculus Rift CV1 System. As an example, Universal Audio released two versions of the UAD-2 DSP Accelerator Cards, an external DSP unit and another made for PCIe slots in a desktop computer: What is the UAD-2 Satellite? UAD-2 Satellite is a FireWire 800/400 DSP accelerator that runs the growing library of UAD Powered Plug-Ins. UAD plug-ins are widely recognized as the highest quality tools for mixing and mastering, with an emphasis on emulations of classic analog gear. The UAD-2 Satellite ships with the Analog Classics bundle, which gives you vintage compression, EQ and reverb tools, right out of the box. How is the UAD-2 Satellite different from UAD-2 DSP Accelerator Cards? The UAD-2 DSP Accelerator Cards are made for PCIe slots in a desktop computer or expansion chassis. UAD-2 Satellite, on the other hand, is an external DSP unit (with power supply) that connects to Intel-based iMacs, MacBook Pros and 64-bit Windows 7-based PCs via a FireWire 800 or FireWire 400 connection. (Note that Windows 7 PCs require an additional PCIe-to-FireWire adaptor.) Both the UAD-2 PCIe and UAD-2 Satellite systems can run the full library of UAD-2 Powered Plug-Ins. The differences between the two products are primarily their different connection protocols. PCIe has greater bandwidth and lower latency than FireWire, but FireWire is more convenient and portable. <i>See Universal Audio, UAD-2 Satellite Firewire DSP Accelerators Basics & FAQ²⁰</i>

²⁰ <https://www.uaudio.com/blog/uad-2-satellite-basics-faq/>

Claim	The Oculus Rift CV1 System Exemplary Disclosures
	Universal Audio Announces new line of UAD-2 Satellite USB DSP Accelerators <i>— The rich analog sound of UAD Powered Plug-Ins, available soon over USB 3 for Windows-based PCs —</i> SCOTTS VALLEY, CA • April 7, 2016 — Universal Audio, a leading manufacturer of professional audio recording hardware and software, is proud to announce the new line of UAD-2 Satellite USB DSP Accelerators, shipping Q2 2016. See Universal Audio, Universal Audio Announces new line of UAD-2 Satellite USB DSP Accelerators²¹ By using these types of devices, the computer offloads processing power from the computer’s CPU into the one built into the device.²² To the extent that Plaintiff argues that the Oculus Rift CV1 System alone does not disclose to a POSA using a DSP for processing binaural sound, using a DSP for processing binaural audio would have been an obvious implementation. As provided in the example above, DSPs were commonly available for purchase to use with computers like those used in the Oculus Rift CV1 System well before the earliest priority date of the ’836 patent. And POSAs would have understood the advantages of using a DSP for processing of spatial sound, including efficient processing of digital signals while using little power or space. Accordingly, this limitation would have been obvious in light of the Oculus Rift CV1 System alone or in combination with any

²¹ <https://www.uaudio.com/press/releases/2016/uad-2-satellite-usb-announcement/>.

²² See <https://www.sweetwater.com/sweetcare/articles/universal-audio-uad-plug-in-dsp/> (explaining that a DSP “is a way to offload the processing power of plug-ins from your computer’s process to the processor built into” UAD’s device so that “[b]y allocating all UAD processing to the external processor, your computer’s internal processor will have more bandwidth for other operations.”).

Claim	The Oculus Rift CV1 System Exemplary Disclosures
	applicant admitted prior art, the knowledge of one of ordinary skill in the art, or any one or more of the references identified in Defendants’ Invalidity Contentions under Sections IV.J.1 and IV.J.6 for at least the reasons stated in Defendants’ Invalidity Contentions cover pleading. <i>See, e.g., Begault 2000</i> at 20 (“The technological context for implementing 3-D sound is directly tied to both the evolution of digital signal processing (DSP) chips for the defense industry, and the commercial introduction of digital audio in the music industry. ...Simultaneously, the development of DSP chips, which are capable of millions of computational instructions per second, have over time been increasingly used in everyday audio and graphics applications, and not merely for missile guidance or radar systems.”), 100-101 (“Within a virtual reality or multimedia application, 3-D sound processing is almost always best accomplished digitally, using audio DSP chips to manipulate signal sources. A DSP can be used to process any type of digitally stored information: visual, audio, subsonic vibration, or magnetic fields. ... Audio DSP chips typically are designed to perform a limited set of digital DSP instructions <i>very quickly</i>—i.e., in real time.”), 105-106 (“The basis of 3-D sound processing lies in imitation of the spatial cues present in natural spatial hearing, where the binaural HRTF imposes spatially dependent spectral modifications and time delays on an incoming wavefront to the hearing system. In virtual spatial hearing, it is possible to imitate these modifications using a DSP as a digital filter. One can obtain HRTF data by several methods (described later) and then use digital filters--specifically, two different h(n) s, termed a binaural impulse response--to produce a desired virtual acoustic source position. But before turning to this process, it's necessary to cover the basics of digital filtering.”), 165-170 (DSP for HRTF processing), 185-187 (same); Jin at 308 (“In virtual reality applications, sound sources are often presented over headphones to give precise control over the virtual auditory environment. Head-related transfer functions (HRTFs) are used to create virtual auditory space and have commonly been recorded on humans and manikins to allow externalization and spatialisation of sound sources presented in a binaural audio display. An HRTF is an acoustic transfer function that describes the sound pressure transformation from a location in the free-field to the listener’s eardrum [4]. HRTFs contain the acoustic cues necessary for spatial hearing: the interaural time difference cue (ITD), the interaural level difference cue (ILD) and the spectral transformations applied by the outer ear. More details about the acoustic cues for spatial hearing can be found in [5].”), <i>id.</i> (“Head-orientation sensors have also been used with binaural audio systems to heighten the experience of the user by allowing head movement....Hence the real conflict is between real-time head-tracking and the number of simultaneous sound sources. Dedicated hardware can be used to achieve 3D audio with headtracking, but this can turn out to be costly, e.g., Lake Technology’s Huron processor uses one DSP chip per sound source [6]. This paper presents a method that has been incorporated

Claim	The Oculus Rift CV1 System Exemplary Disclosures
	into a 3D audio playback engine (3DApe) that runs on standard PC hardware and allows real-time headtracking to be maintained with an unlimited number of simultaneous sound sources”); Tanaka at 3:37-44 (“Moreover, another aspect of such an apparatus resides in that data for a sound image localization processing by the convolvers is supplied as data for a time-base impulse response (IR). Thereby, an HRTF (thus, head-related transfer characteristics) can be accurately approximated without deteriorating the sound image localization and the size of a circuit (thus, the number of coefficients of the convolvers) can be even smaller.”), <i>id.</i> at 14:4-20 (“Further, the practical configuration of each of the convolvers 1 and 2 will be described hereinbelow. Namely, the convolvers 1 and 2 are implemented by using, for example, digital signal processor (DSP) or the like as filters of the asymmetrical finite impulse response (FIR) type in which a RAM for storing convolution operation coefficients.”); Jarvinen at 8:1-34 (“The processor 70 may be embodied in a number of different ways. For example, the processor 70 may be embodied as one or more of various processing means such as a coprocessor, microprocessor, a controller, a digital signal processor (DSP), processing circuitry with or without an accompanying DSP, or various other processing devices including integrated circuits such as, for example, an ASIC (application specific integrated circuit), an FPGA (field programmable gate array), a microcontroller unit (MCU), a hardware accelerator, a special-purpose computer chip, or the like.”); Sauk at 7:24-28 (disclosing a “sound environment manager” that “can be implemented by” “one or more digital signal processors.”); Shivappa at 28:1-9, 28:21-24 (disclosing a “processor 710, such as a central processing unit (CPU) or a digital signal processor (DSP)” that is “configured to generate [an] output spatialized audio signal”); Otto at 13:50-53 (Explaining that its “DSP strategy” provides optimal performance in terms of directivity of the sound beam created and of the stability of the binaural rendering at higher frequencies”); Brown at Abstract (providing a model for synthesizing binaural sound” and noting that the “the model permits efficient implementation in DSP hardware, and thus facilitates real-time operation”); U.S. Patent No. 9,232,336 (“Nishio”) at 10:25-33 (“For reference’s sake, the normalization processing circuit 10 generates the normalized head related transfer function HN of the cross talk component with respect to the assumed sound source direction position by performing a similar computation processing also with regard to the cross talk component and stores this in a predetermined storage unit. It should be noted that the respective signal processing in the normalization processing circuit 10 can be performed mainly by a DSP (Digital Signal Processor)”); U.S. Patent No. 8,873,761 (“Fukui”) at 15:63-66 (“All the signal processing in the block diagram in FIG. 1 for explaining the embodiment of the measurement method of head related transfer functions can be performed in a DSP (Digital Signal Processor)”).

Claim	The Oculus Rift CV1 System Exemplary Disclosures
	Furthermore, in 8K's view, the term DSP encompasses any/all hardware <i>or software</i> that processes digital signals for 3D audio. Under that interpretation, limitation 14[c] is disclosed and/or rendered obvious by numerous prior art references and systems, including the prior art cited immediately above and the Oculus Rift CV1 System's audio processing, including the digital signal processing logic provided by third-party HRTF spatialization supported by, for example, Unreal Engine 4. Epic Games' <i>Showdown</i>, for example, used Unreal Engine 4 and audio spatialization to create binaural sounds using HRTFs.²³ Further, <i>Showdown</i> was available for the Oculus Rift CV1 System.²⁴ And as with <i>Showdown</i>, <i>EVE: Valkyrie</i> also incorporated Unreal Engine 4, and so was capable of generating binaural sound using HRTFs. See PCWorld, "Eyes-on: EVE: Valkyrie adds Unreal Engine 4, Battlestar Galactica's Katee Sackhoff" (May 1, 2014)²⁵ The logic provided by the Unreal Engine 4 would be a DSP <i>under 8K's interpretation</i> of DSP because it processes digital audio signals to create binaural sound.
8[e] that processes the sound for the image with far-field head-related transfer functions (HRTFs) while the electronic	<u>Oculus Rift CV1 System</u> The Oculus Rift CV1 System discloses and/or renders obvious, alone or in combination with other prior art, a DSP (see 8[d]) that "processes the sound for the image with far-field head-related transfer functions" as embodied in the product itself and as reflected in other prior art references that describe it. For example:

²³ See Unreal Engine, "Showdown Cinematic VR Experience Released for Free!" (Sept. 2, 2015), available at <https://www.unrealengine.com/en-US/blog/showdown-cinematic-vr-experience-released-for-free>; see also I&T Today, "Virtually Speaking of Virtual Reality" (at least as of Sept. 21, 2015)²³ (explaining that "360-degree VR Audio" was possible "using Epic Games' Unreal Engine 4 technology").

²⁴ See Game Developer, Now you can take apart Epic's UE4 VR tech demo to see how it works, available at <https://www.gamedeveloper.com/design/now-you-can-take-apart-epic-s-ue4-vr-tech-demo-to-see-how-it-works>; see also Unreal Engine, "Showdown Cinematic VR Experience Released for Free!" (September 2, 2015), available at <https://www.unrealengine.com/en-US/blog/showdown-cinematic-vr-experience-released-for-free> (explaining that the entire "Unreal Engine 4-based content library" for "Showdown" was compatible with the HTC Vive and available for download).

²⁵ <https://www.pcworld.com/article/439060/eyes-on-eve-valkyrie-adds-unreal-engine-4-battlestar-galacticas-katee-sackhoff.html>.

Claim	The Oculus Rift CV1 System Exemplary Disclosures
device is located at the near-field distance from the head of the user.	As explained above, in <i>Showdown</i> , sounds change based on the location of the user and virtual images. In <i>Showdown</i> , you view a battle against a giant robotic alien boss. <i>Showdown</i> was originally unveiled for the

reveal of the Oculus Rift Crescent Bay prototype at Oculus Connect 2014. *See* Unreal Engine, Content Detail, Showdown VR Demo (further explaining that the demo works with “the Oculus DK1 and above”)²⁶



See Video of Video of Oculus Rift CV1 - Showdown.

²⁶ <https://www.unrealengine.com/marketplace/en-US/product/showdown-demo>

Claim	The Oculus Rift CV1 System Exemplary Disclosures
	Showdown used the Unreal Engine 4 for 3D audio. The entire “Unreal Engine 4-based content library” for <i>Showdown</i> was compatible with the Oculus Rift CV1 System and available for download as early as September 2, 2015: Our premier VR experience takes you through a cinematic, bullet-time inspired action scene. <i>Showdown</i> took Oculus Connect, GDC and SIGGRAPH by storm, and now you can download it for free, including its entire Unreal Engine 4-based content library! The interactive demo is compatible with Oculus DK2 and up, Sony PlayStation Morpheus and HTC Vive SteamVR.  The project and all assets are available for download immediately through the Learn tab on the Epic Games launcher.

Claim	The Oculus Rift CV1 System Exemplary Disclosures
	<i>See</i> Unreal Engine, “Showdown Cinematic VR Experience Released for Free!” (September 2, 2015)²⁷ (“This direct capture of the Unreal Engine 4 Showdown demo takes you through a guns-blazing scenario where ammo and debris slices through the environment in slow motion. Watch a fiery car barrel past overhead, and face off with a colossal mech enemy. Available for free through the Epic Games launcher, Showdown is compatible with Oculus DK2 and up, Sony PlayStation Morpheus, and HTC Vive SteamVR. Get UE4 and loads of content for free at https://www.unrealengine.com.”). “Two years ago, UE4 introduced support for third party HRTF spatialization. In 4.16, spatialization plugins can customize the behavior of HRTF processing on a per-source basis. Users configure spatialization plugins with Spatialization Plugin Settings assets. The Steam Audio plugin provides robust HRTF processing and lets users choose between nearest-neighbor and bilinear HRTF interpolation.” <i>See</i> Steam, “Steam Audio for Unreal Engine 4” (May 3, 2017).²⁸ “Case in point: the Oculus Rift Crescent Bay prototype demo entered a new, immersive level with 3-D sound and positional head tracking. The demo is so believable, people have actually been known to exhibit the signs of vertigo while ‘perched’ on the edge of a virtual skyscraper. Developed using Epic Games’ Unreal Engine 4 technology, the demo showed off brand new 360-degree VR Audio by allowing users to experience a T-Rex on the loose a warehouse and then placing them in the middle of a street battle between futuristic police and a giant robotic alien boss. All the while, the sounds come from every direction, changing per your ‘location,’ thanks to the HRTF (Head Related Transform Function). Oculus showed off this technology on both its PC-based device and Samsung VR, the mobile HMD. Adding immersive audio to the already mind-blowing VR visuals keeps Oculus at the top of the game in these early days.”

²⁷ <https://www.unrealengine.com/en-US/blog/showdown-cinematic-vr-experience-released-for-free>.

²⁸ <https://store.steampowered.com/news/app/250820/view/2898585530113882274>.

Claim	The Oculus Rift CV1 System Exemplary Disclosures
	<i>See</i> I&T Today, “Virtually Speaking of Virtual Reality” (at least as of Sept. 21, 2015).²⁹ The Showdown demonstration can be compiled using Unreal Engine 4.9.2, which was released on October 1, 2015, as a patch to Unreal Engine 4.9. <i>See</i> Unreal Engine, “Showdown Cinematic VR Experience Released for Free!” (Sept. 2, 2015); Softpedia, “Epic Games Releases Unreal Engine 4.9.2 Hotfix to Patch over 20 Issues” (Oct. 1, 2015)³⁰; Source Code for Showdown.³¹ Unreal Engine 4.9.2 supports the “Oculus Audio” SDK plug-in, which provides the option to use HRTF spatialization to generate binaural sound. <i>See</i> Designing Sound, “3D Audio: Weighing the Options” (Apr. 17, 2015)³² (“And just recently at GDC 2015 they’ve taken it a step further and released their own 3D audio plugin, Oculus Audio SDK (currently in alpha), based on the same licensed technology.”); Voices of VR, #124: Rod Haxton on VisiSonics’ RealSpace 3D Audio Licensed to Oculus, Personalized HRTFs, & Their Audio Panoramic Camera” (Apr. 15, 2015)³³ (“With RealSpace™ 3D Audio, they’re able to go beyond panning to simulate the elevation and whether the sound is in front or behind you. They process audio in a way that’s analogous of doing ray-tracing for ears where they take true material audio reflections and do calculations that are based upon Sabine’s reverberation equation.”); Game Developer, “Past, Present and Future of Music and Audio in VR” (Mar. 1, 2016)³⁴ (“Oculus is bringing binaural audio to virtual reality by licensing VisiSonic's RealSpace3D binaural audio engine for incorporation into its Oculus Audio Software Development Kit (SDK) for the Oculus Rift (pictured right).”).

²⁹ <https://innotechtoday.com/virtually-speaking/>.

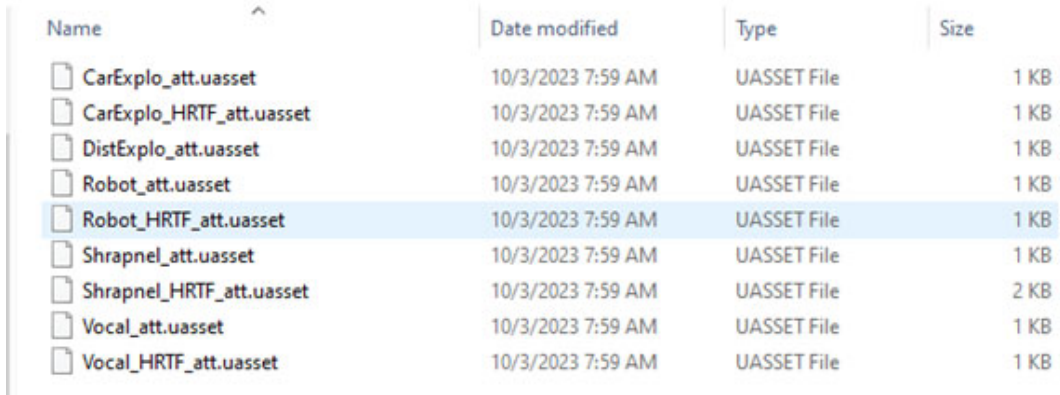
³⁰ <https://news.softpedia.com/news/epic-games-releases-unreal-engine-4-9-2-hotfix-to-patch-over-20-issues-493390.shtml>.

³¹ META-8KHZ_00048273.

³² <https://designingsound.org/2015/04/17/3d-audio-weighing-the-options/>.

³³ <https://voicesofvr.com/124-rod-haxton-on-visisonics-realspace-3d-audio-licensed-to-oculus-personalized-hrtfs-their-audio-panoramic-camera/>.

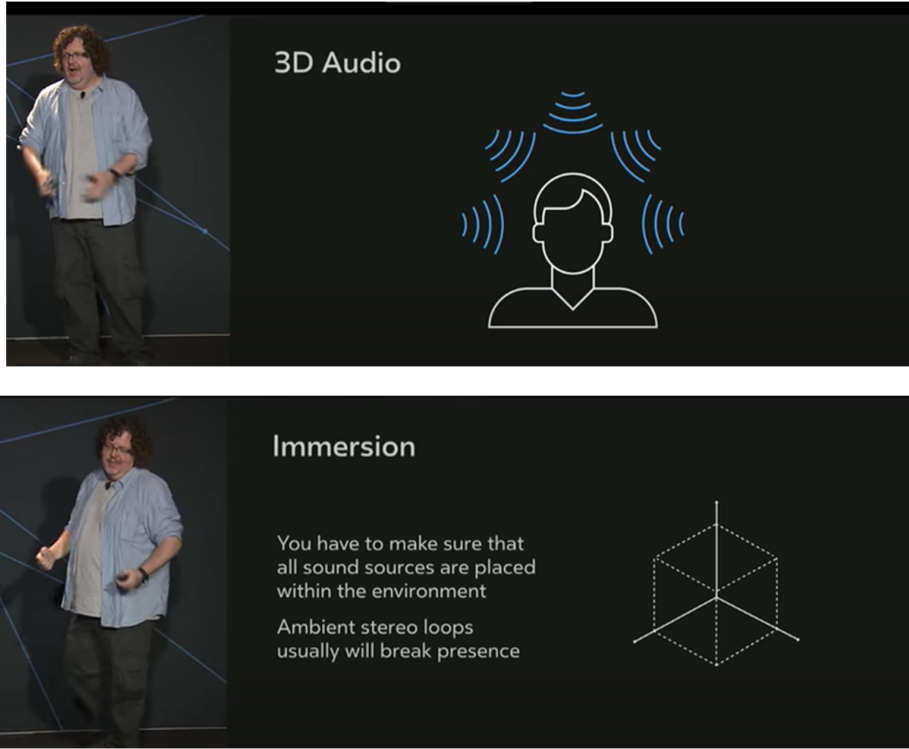
³⁴ <https://www.gamedeveloper.com/audio/past-present-and-future-of-music-and-audio-in-vr>.

Claim	The Oculus Rift CV1 System Exemplary Disclosures
	Additionally, the Showdown source code identifies elements that use HRTFs, which can be used to generate binaural sound:  Source Code for Showdown (under Content > Audio > Attenuation). As with Showdown, EVE: Valkyrie also incorporated Unreal Engine 4, and so was capable of generating binaural sound using HRTFs. See PCWorld, “Eyes-on: EVE: Valkyrie adds Unreal Engine 4, Battlestar Galactica’s Katee Sackhoff” (May 1, 2014)³⁵ (“At Thursday’s EVE: Valkyrie keynote at the annual EVE fanfest, CCP announced that the game is moving over to Unreal Engine 4. Most of the Valkyrie team was previously on CCP’s first-person shooter, Dust 514, so they were used to Unreal already and felt it would be beneficial to move away from the game’s previous engine, Unity.”). Additionally, as discussed in the context of Unreal Engine’s support of the Oculus Audio SDK, Oculus’s own Oculus Audio SDK supported use of HRTFs to provide audio spatialization and binaural sound:

³⁵ <https://www.pcworld.com/article/439060/eyes-on-eve-valkyrie-adds-unreal-engine-4-battlestar-galacticas-katee-sackhoff.html>.

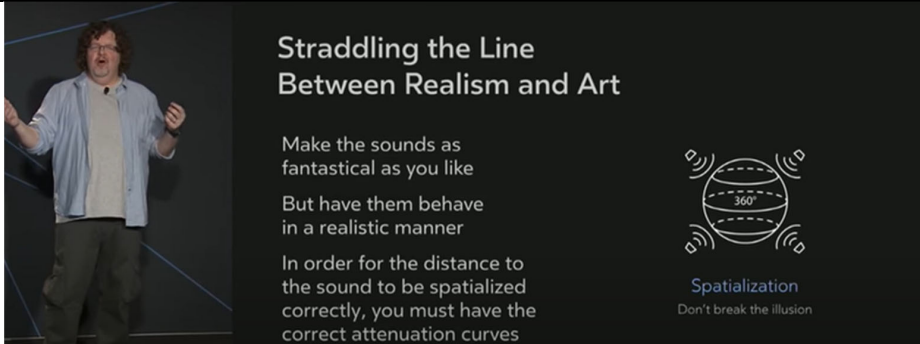
Claim	The Oculus Rift CV1 System Exemplary Disclosures
	Supported Features This section describes supported features. Spatialization Spatialization is the process of transforming monophonic sound sources to make them sound as though they originate from a specific desired direction. The Oculus Audio SDK uses head-related transfer functions (HRTFs) to provide audio spatialization through the C/C++ SDK and plugins. Note: It is important that all sounds passed to Oculus Audio Spatializers are monophonic - stereophonic rendering will be handled by our spatialization, and must not be applied over additional stereophonic rendering provided by your game engine or library. Environmental Modeling HRTFs provide strong directional cues, but without room effects, they often sound dry and lifeless. Some environmental cues (e.g., early reflections and late reverberation) are also important in providing strong cues about the distance to a sound source. The Audio SDK supports early reflections and late reverberations using a simple 'shoebox model,' consisting of a virtual room centered around the listener's head, with four parallel walls, a floor, and a ceiling at varying distances, each with its own distinct reflection coefficient. <i>See Oculus, “Documentation, Oculus Audio SDK Guide, Features” (Dec. 29, 2015)³⁶ (referencing Audio SDK v0.10, v0.11, and v1.0 Release Notes, available as of December 2015); see also Designing Sound, “3D</i>

³⁶ <https://web.archive.org/web/20151229032318/https://developer.oculus.com/documentation/audiosdk/latest/concepts/audiosdk-features/>.

Claim	The Oculus Rift CV1 System Exemplary Disclosures
	Audio: Weighing the Options” (Apr. 17, 2015)³⁷ (identifying Oculus’s 3D audio plugin, Oculus Audio SDK v0.9.2 as of April 2015); Meta Question, “Rift SDK 1.0 Shipping to Developers with Final Rift Hardware” (Dec. 21, 2015)³⁸ (“Rift SDK 1.0 is shipping this week to developers with early builds of final Rift hardware.”). 

³⁷ <https://designingsound.org/2015/04/17/3d-audio-weighing-the-options/>.

³⁸ <https://developer.oculus.com/blog/rift-sdk-1-0-shipping-to-developers-with-final-rift-hardware/>.

Claim	The Oculus Rift CV1 System Exemplary Disclosures
	 Straddling the Line Between Realism and Art Make the sounds as fantastical as you like But have them behave in a realistic manner In order for the distance to the sound to be spatialized correctly, you must have the correct attenuation curves Spatialization Don't break the illusion “3D audio is critical for creating a believable virtual world, and sound design for VR is very different from traditional games or movies. This talk will cover VR audio techniques including building immersive ambiences, attenuation curves, mixing and player focus. You’ll hear some of the sound design tricks used in the Oculus demos, and learn more about how to work with the Audio SDK to create authentic and compelling experiences.” See Meta Quest, “Oculus Connect 2: 3D Audio: Designing Sounds for VR” (Nov 11, 2015)³⁹ (discussing Oculus’s use of 3D audio). “The directional audio headphones were a new addition too. Directional audio is now part of the Oculus SDK, and while users can choose to use their own audio headphones, the goal is for the Oculus Rift to be a complete solution with a standardized experience delivery.” See Tom’s Hardware, “Hands On With Oculus Rift Crescent Bay: Finally Achieving Presence” (Sept. 23, 2014)⁴⁰ (discussing an early implementation of 3D audio on Oculus’s Crescent Bay).

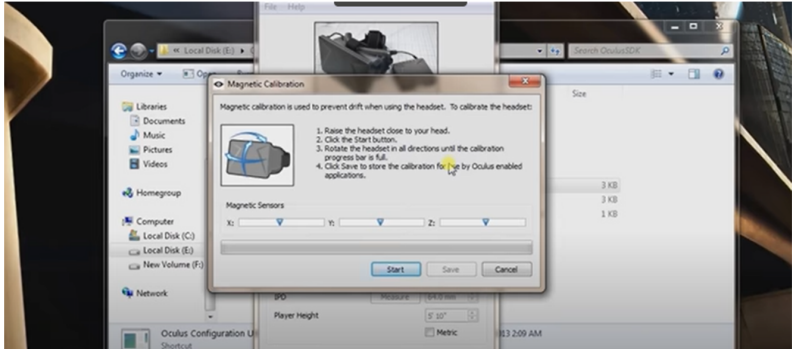
³⁹ <https://www.youtube.com/watch?v=IAwFN9sFcso>.

⁴⁰ <https://www.tomshardware.com/news/oculus-vr-oculus-rift-crescent-bay,27741.html>.

Claim	The Oculus Rift CV1 System Exemplary Disclosures
	“The core features: 360-degree tracking (there are LEDs on the back of the headset now), a quicker refresh rate, and optional integrated audio (you can move the small attached earbuds out of the way to use your own headphones) along with 360 VR audio software powered by RealSpace 3D’s audio system. <i>See</i> PCWorld, “New Oculus Rift ‘Crescent Bay’ Prototype Packs Integrated Audio and 360-Degree Tracking” (Sept. 20, 2014)⁴¹ (discussing an early implementation of 3D audio on Oculus’s Crescent Bay). “For Crescent Bay, Oculus put together a series of short demos that lasted about five minutes I’d estimate. All of these used positional audio, so as you turned or leaned in, you got a clear sense of the sounds moving around you. This isn’t anything really new, as we’ve had audio HRTF (Head Related Transfer Functions) doing positional audio for a while now, but combined with the goggles and stereoscopic 3D it’s very immersive. Oculus has licensed Visisonics’ 3D audio libraries, though they’re doing a lot of customizations to make things work with the Oculus Rift obviously” <i>See</i> AnandTech, “Oculus Demos Crescent Bay and 3D Audio” (Jan. 13, 2015)⁴² (discussing an early implementation of 3D audio on Oculus’s Crescent Bay). “Truth be told, no hunting was required as RealSpace 3D not only have 2 demos available for anyone to download and try for themselves but one of them is a VR specific, DK2 enabled version of the now historic Tuscany VR demo. I’ve listened to a lot of surround sound systems and I’ve experienced a lot of DSP/processed 3D audio techniques plus countless binaural tracks, but this demo genuinely set a new benchmark for me. Luckily, the Tuscany demo was an entirely different story.

⁴¹ <https://www.pcworld.com/article/435380/oculus-announces-tk.html>.

⁴² <https://www.anandtech.com/show/8876/oculus-demos-crescent-bay-and-vr-audio>.

Claim	The Oculus Rift CV1 System Exemplary Disclosures
	I've listened to a lot of surround sound systems and I've experienced a lot of DSP/processed 3D audio techniques plus countless binaural tracks, but this demo genuinely set a new benchmark for me. The demo is identical to the Tuscany experience we're all familiar with except that objects within the world act as focal points for demonstrating a facet of RealSpace 3D Audio's techniques. Approach the fountain (flashing red, somewhat disconcertingly) and you'll be treated first to the sound of the fountain. Nothing special perhaps, but when you pan your head, the sound of cascading water is anchored in 3D space exactly as expected, including when directly behind you. This effect is somewhat overcooked, but nevertheless impressive." See RoadtoVR, "A Preview of Oculus' Newly Licensed Audio Tech" (Oct. 8, 2014)⁴³ (discussing an early implementation of 3D audio on Oculus's DK2). 

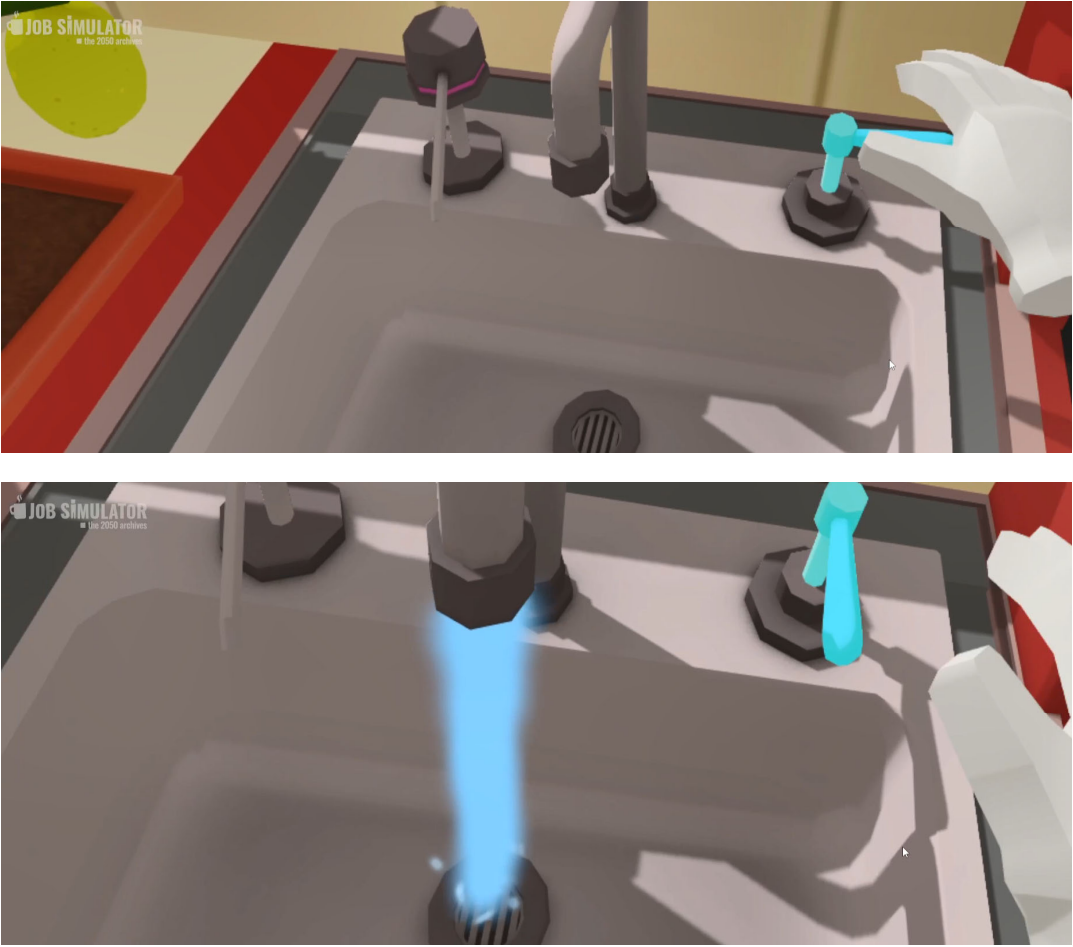
⁴³ <https://www.roadtovr.com/oculus-rift-dk2-realsense-3d-audio-preview-download/>.

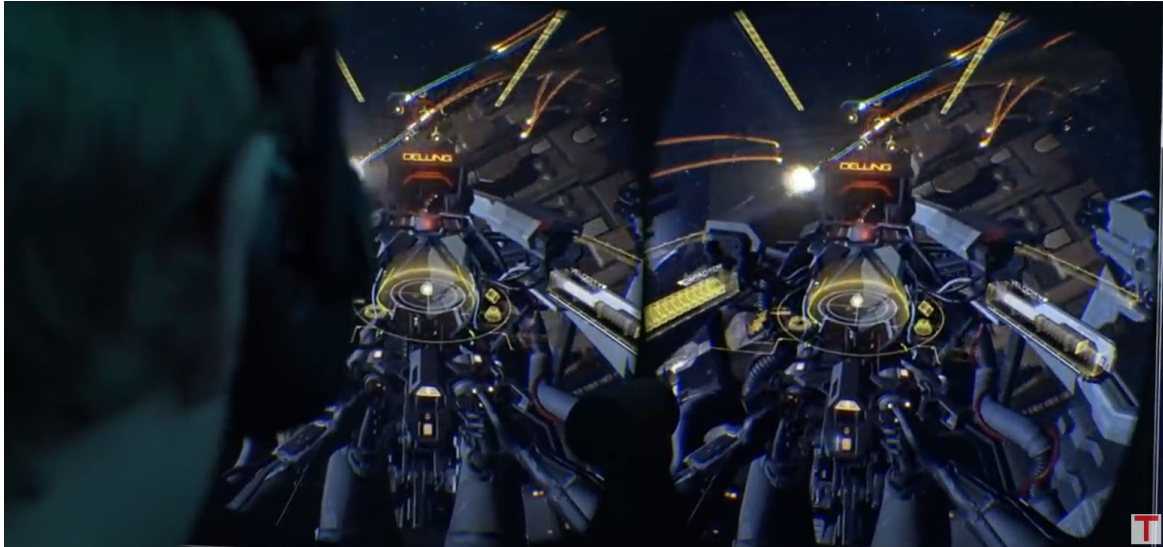
Claim	The Oculus Rift CV1 System Exemplary Disclosures
	See GeniusPieTrap, “Oculus Rift VR DK1 Complete Easy Setup” (Aug 20, 2013)⁴⁴ (discussing an early implementation of 3D audio on Oculus’s DK1). Other tools were available that enabled headphones to play spatialized sound, including binaural sound, using HRTFs, such as Rapture3D, which is an OpenAL driver. See, e.g., WildCat, Rapture3D Audio Demonstration in UT3 (Jan. 21, 2010)⁴⁵ (“Rapture3D is an OpenAL driver that can produce 3D headphone surround sound using HRTFs.”); Steam, “Steam Audio” (Aug. 24, 2017)⁴⁶ (indicating it was possible to use OpenAL with Steam). As shown below in the figures depicting scenes from <i>Job Simulator</i>, <i>EVE: Valkyrie</i>, and the <i>Showdown</i> demo, respectively, in the virtual world, the users see various objects and characters and sounds emanate from those objects, which can be at far-field distances from the user. As explained above, HRTFs are used

⁴⁴ <https://www.youtube.com/watch?v=iqgr4XCjpk&t=799s>.

⁴⁵ <https://www.youtube.com/watch?v=lqqiIR017SQ>.

⁴⁶ <https://steamcommunity.com/app/596420/discussions/0/1471969431584015443/>.

Claim	The Oculus Rift CV1 System Exemplary Disclosures
	to process these sounds, and the images are (or are obviously) in the near-field. Thus, the Oculus Rift CV1 System uses (or would have obviously used) far-field HRTFs to process this sound. 

Claim	The Oculus Rift CV1 System Exemplary Disclosures
	<i>See Video of Oculus Rift CV1 – Job Simulator</i>⁴⁷ (showing the user interacting with virtual objects where sound localizes).  <i>See Adam Savage’s Tested, “EVE: Valkyrie on Oculus Rift VR Playtest!”</i> (Dec. 10, 2015)⁴⁸

⁴⁷ META-8KHZ_00047848.

⁴⁸ <https://www.youtube.com/watch?v=UmEJmRxfz80>.

Claim	The Oculus Rift CV1 System Exemplary Disclosures
	 <i>See Video of Oculus Rift CV1 – Showdown.</i>⁴⁹

⁴⁹ META-8KHZ_00047851.

When users play these types of games (and other applications), the headset is located at the near-field distance from the head of the user because it is worn on the user's head:



See Adam Savage's Tested, "Oculus Rift CV1 + Oculus Touch Controller Hands-On + Impressions!" (June 18, 2015).

To the extent Plaintiff argues that the Oculus Rift CV1 System does not disclose this limitation, either expressly, implicitly, and/or by inherency, a person of ordinary skill in the art would have determined that the limitation would have been obvious in light of each of the Oculus Rift CV1 System alone or in combination with any applicant admitted prior art, the knowledge of one of ordinary skill in the art, or any one or more of the references identified in Defendants' Invalidity Contentions under Sections IV.J.8 and IV.J.6 for at least the reasons stated in Defendants' Invalidity Contentions cover pleading. See, e.g., **Algazi 2011** at 35 ("The HRTF is defined as the ratio of the Fourier transform of the sound pressure developed at the ear to the Fourier transform of the sound pressure developed at the location of the center of the listener's head with the listener absent. **This frequency-domain definition has the advantage that the resulting HRTF is**

Claim	The Oculus Rift CV1 System Exemplary Disclosures
	essentially independent of range when the source is in the far field. Most HRTF measurements are made under these conditions. The far-field range dependence is easily obtained merely by adding the propagation delay and the inverse range dependence. The inverse Fourier transform of the HRTF is the head-related impulse response (HRIR). If h_1 is the head-related impulse response for a distant source and c is the speed of sound, then the anechoic pressure response to an impulsive velocity source at a distance r is proportional to $h_1 t^2/c^2 /r$. The situation is more complicated when the source has a complicated radiation pattern or is distributed or is close to the head [16], and we limit our discussion to an isotropic point source in the far-field.”); Begault 2000 at 12, 112 (“The 3-D sound system designer in most cases will want to obtain a library of HRTF measurements, from which particular sets can be selected on the basis of either user preference or behavioral data. Several corporate and university research projects are underway where HRTF measurements are collected and subsequently utilized for digital filtering. Someday, a collection may be available on a CD-ROM; already, some HRTFs are available over computer networks (see Chapter 6).”), 118 (“A review of the literature shows that KEMAR’s HRTFs have been used many times in both 3-D sound applications and localization studies (e.g., Kendall, Martens, and Wilde, 1990).”), 139, 140, 170 (“The AL-204 (see Figure 5.9), was an early four-channel DSP-based convolution device that used HRTFs based on measurements of the KEMAR mannequin head (Figure 4.25) made at Northwestern University (cf. Kendall, Martens, and Wilde, 1990).”); Zhou at 1044-45 (“An alternative way to generate 3D sound is to use open source software development kits (SDKs), which have already incorporated the general HRTFs database and simple model of environment to generate 3D sound. The minimum requirement of these SDKs to generate 3D sound is to update the relative position of the virtual sound source to the head coordinate system.”), <i>id.</i> at 1046 (“For easy implementation of 3D sound generation, several open source SDKs, have been developed such as OpenAL (Loki Entertainment Software) and FMOD (Firelight Technologies). These use the general HRTFs database and modeling environment in a relative simple manner. However, as mentioned in Section 1, for AR systems 3D sound does not play a significant role to tell the depth (or the distance of the frontal sound sources) because most of actual AR spaces are relatively of small size (for example small offices).”); Algazi 2001 at 99 (“Head-related transfer functions (HRTFs) capture the sound localization cues created by the scattering of incident sound waves by the body, and play a central role in spatial audio systems. Most HRTF-based commercial systems convolve the input signal with a single, “standard” head-related impulse response (HRIR), and several studies have employed the public-domain dataset for the KEMAR mannequin [1]. ... The CIPIC Interface Laboratory at U.C. Davis has measured HRTFs at high spatial resolution for more than 90 subjects. Release 1.0 — a public-domain subset for 45 subjects (including KEMAR with large and with small pinnae) — is available by downloading from our web site (http:// interface.cipic.ucdavis.edu).

Claim	The Oculus Rift CV1 System Exemplary Disclosures
	In addition to including impulse responses for 1250 directions for each ear of each subject, the database includes a set of anthropometric measurements that can be used for scaling studies. This paper describes the content of the database, and briefly describes the characteristics of the data. ... All HRTFs were measured with the subject seated at the center of a 1-m radius hoop whose axis was aligned with the subject's interaural axis. The position of the subject's head was not constrained, but the subject could monitor his or her head position [7]. ... Sound source location was specified by the azimuth angle ; and elevation angle < in interaural-polar coordinates.");100, 102 ("We hope that public availability of the CIPIC HRTF database, augmented with anthropometric measurements, will facilitate further research in the understanding, modeling, and use of individualized HRTFs."); Rombloom at Abstract ("It is difficult to present near-field virtual audio displays using available HRTF filters, as most existing databases are measured at a single distance in the far-field of the listener's head. Measuring near-field data is possible, but would quickly become tiresome due to the large number of distances required to simulate sources moving close to the head. For applications requiring a convincing near-field virtual audio display, one could compensate the far-field HRTF filters with a scheme based on 1/r spreading roll off."); <i>id.</i> at 1-2 ("When binaural synthesis is chosen to simulate 3D sound sources over headphones, the Head-Related Transfer Functions (HRTF) used have most often been measured at a single distance in the far-field of the listener. Unfortunately, including a variety of near-field distances would substantially increase the required number of physical measurements. To avoid this cumbersome procedure, it is possible to compensate the existing data using the well known law of '1/r spreading roll off' [5], effectively turning up the volume as you approach the head. ... In this paper, we investigate two complementary methods for simulating near-field sources using common far-field HRTFs."); 3, 4-5 ("In 1999, Brungart showed a systematic mapping between nearfield and far-field HRTFs that depends upon the distance and orientation of a source relative to the head."); Brungart at Abstract ("Researchers have long recognized that the binaural difference cues that dominate auditory localization are independent of distance beyond 1 m but change systematically with distance when source the approaches within 1 m of the listener's head. More recent research has shown that listeners are able to use these binaural cues to determine the distances of nearby sound sources. However, technical challenges in the collection and processing of near-field Head-Related Transfer Functions (HRTFs) have thus far prevented the construction of a near-field audio display. This paper summarizes the current state of research in the localization of nearby sound sources, and outlines the technical challenges involved in the creation of a near-field virtual audio display."); 1 ("However, the current generation of virtual audio displays cannot generate realistic virtual sounds in the "near field" within

Claim	The Oculus Rift CV1 System Exemplary Disclosures
	1 m of the head.”), 2 (“Fig. 1. Head-Related Transfer Functions (HRTFs) for a sound source directly to the left of the listener (90) measured at three distances (1.0 m, 0.25 m, and 0.12 m) from the center of the head. The HRTFs were measured with a Knowles Electronics Manikin for Acoustic Research (KEMAR) and an acoustic point source, and have been normalized by the free-field sound pressure at the center of the head to eliminate the overall effects of distance (Brungart and Rabinowitz, 1999).”); 3 (“These studies have shown that, when the source is within 1 m of the listener’s head, the HRTF changes substantially with distance.”); Gardner 1994 at Abstract (“An extensive set of head-related transfer function (HRTF) measurements of a KEMAR dummy head microphone has recently been completed. The measurements consist of the left and right ear impulse response from a Realistic Optimus Pro 7 loudspeaker mounted 1.4 meters from the KEMAR. This data is being made available to the research community on the Internet via anonymous FTP and the World Wide Web.”); Finnegan at Abstract (“Our results have a significant and intriguing implication for designers of VEs: an incongruent audiovisual display, i.e. where the audio and visual information is intentionally misaligned, may lead to better spatial perception of a virtual scene.”), 3 (“Perceptual binding (i.e. the audio and visual components of the target being perceived together as a whole object) was maintained despite the incongruence between the visual and auditory stimuli.”), 5-7; Andreopoulou at 2; Gupta at 169-172.
CLAIM 10	
10. The electronic device of claim 8, wherein the image is a virtual reality (VR) image, and the display is included with a head mounted display worn on the head of the user.	<u>Oculus Rift CV1 System</u> The Oculus Rift CV1 System discloses and/or renders obvious, alone or in combination with other prior art, “the image is a virtual reality (VR) image, and the display is included with a head mounted display worn on the head of the user” as embodied in the product itself and as reflected in other prior art references that describe it. For example:

Claim	The Oculus Rift CV1 System Exemplary Disclosures
	

Claim	The Oculus Rift CV1 System Exemplary Disclosures
	 <i>See Adam Savage's Tested, "Oculus Rift CV1 + Oculus Touch Controller Hands-On + Impressions!" (June 18, 2015).</i> And the figures below show that the image is a virtual reality image:

Claim	The Oculus Rift CV1 System Exemplary Disclosures
	 <i>See Video of Video of Oculus Rift CV1 - Showdown.</i>