

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

DENTAL IMAGING TECHNOLOGIES CORPORATION,
Petitioner,

v.

3SHAPE A/S,
Patent Owner.

IPR2023-00387
Patent 11,076,146 B1

Before HUBERT C. LORIN, FRANCES L. IPPOLITO, and
MICHELLE N. WORMMEESTER, *Administrative Patent Judges*.

IPPOLITO, *Administrative Patent Judge*.

DECISION
Denying Institution of *Inter Partes* Review
35 U.S.C. § 314(a)

I. INTRODUCTION

Dental Imaging Technologies Corporation (“Petitioner”) filed a Petition (Paper 2, “Pet.”) requesting *inter partes* review of claims 1–6, 8–13, 15, 20–27, and 29 of U.S. Patent No. 11,076,146 B1 (Ex. 1001, “the ’146 patent”). 3Shape A/S (“Patent Owner”) filed a Preliminary Response. Paper 5 (“Prelim. Resp.”).

Under 35 U.S.C. § 314(a), an *inter partes* review may not be instituted unless the information presented in the Petition and any response thereto shows “there is a reasonable likelihood that the petitioner would prevail with respect to at least 1 of the claims challenged in the petition.” Considering the arguments presented, we conclude that there is a reasonable likelihood that Petitioner would not prevail in challenging at least one of claims 1–6, 8–13, 15, 20–27, and 29 of the ’146 patent as unpatentable under the grounds presented in the Petition. Pursuant to § 314, we hereby do not institute an *inter partes* review as to these claims of the ’146 patent.

A. Related Matters

According to Petitioner, the ’146 patent is the subject of civil action in *3Shape A/S v. Carestream Dental LLC et al.*, Case No. 1:22-cv-01829 (N.D. Ga.), which was transferred from *3Shape A/S v. Carestream Dental LLC, Dental Imaging Technologies Corp., and Dental Imaging Technologies Corp. d/b/a Dexis*, Case No. 6:21-cv-01110 (W.D. Tex.), filed October 26, 2021. Pet. 72–73. Petitioner also identifies *3Shape A/S v. Medit Corporation*, Case No. 6:22-cv-00443 (W.D. Tex.), filed May 2, 2022, as another case in which the ’146 patent is the subject of civil action. *Id.* at 73.

B. The '146 Patent (Ex. 1001)

The '146 patent relates generally to an apparatus and a method for optical 3D scanning of an object's surfaces, and more particularly to direct scanning of teeth and surrounding soft-tissue in the oral cavity.

Ex. 1001, Abstract, 1:24–30. The scanner obtains the 3D geometry of the object's surfaces and also determines the color of the object's surfaces. *Id.* at 2:43–45, 33:45–34:18.

Figure 8, reproduced below, shows a schematic presentation of a device for simultaneous scanning of a surface's shape and color according to an embodiment of the invention. *Id.* at 26:37–39.

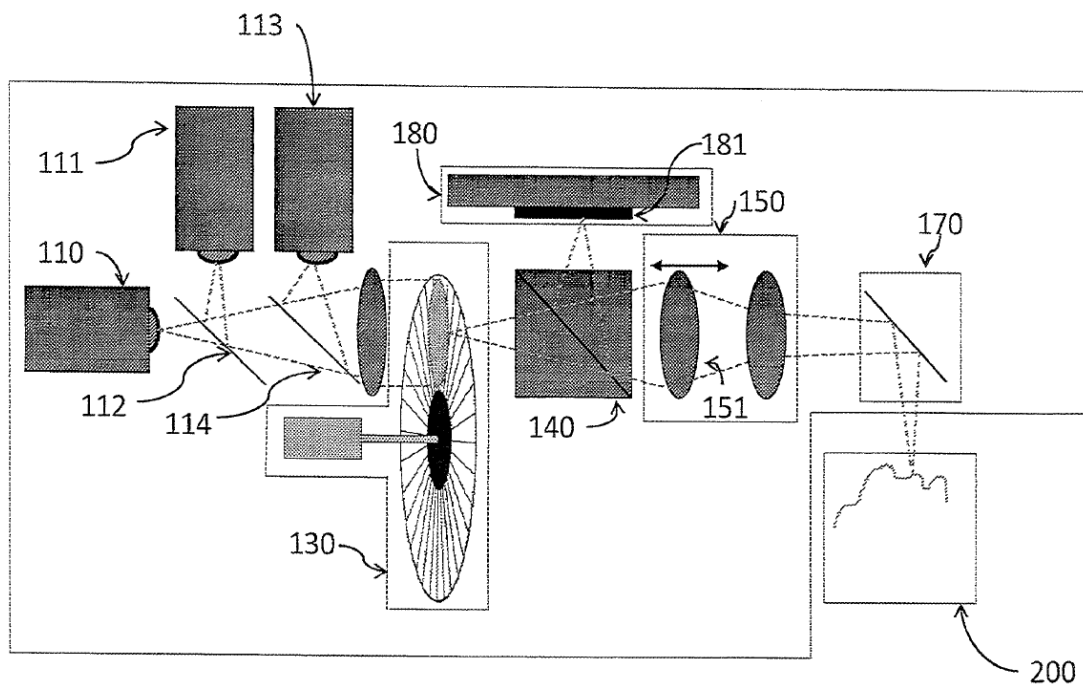


Fig. 8

Figure 8, reproduced above, shows a schematic presentation of a device for simultaneous scanning of a surface's shape and color according to an embodiment of the invention. *Id.* at 26:37–39.

Referring to Figure 8, components of hand-held scanner 100 (annotation not shown) comprise a tip for entering into a cavity, light source

110, optics 120 (annotation not shown) to collect light from the light source, pattern generation means 130, beam splitter 140, image sensor and electronics 180, a lens system for transmitting and imaging the light between the pattern, the object being scanned, and camera 180. *Id.* at 27:20–28. The light from light source 110 travels back and forth through optical system 150 while system 150 simultaneously images pattern 130 onto the object being scanned 200 and further images the object being scanned onto image sensor 181. *Id.* at 27:28–32. The lens system includes focusing element 151, which can be adjusted to shift the focal imaging plane of the pattern on the probed object 200. *Id.* at 27:32–35. One embodiment of the focusing element physically moves a single lens element back and forth along the optical axis. *Id.* at 27:35–37. The device may include folding optics 170 which directs the light out of the device in a direction different to the optical axis of the lens system. *Id.* at 27:38–40.

Figure 8 depicts three light sources 110, 111, and 113, which emit red, green, and blue light. *Id.* at 33:47–48. The light is merged together to overlap or essentially overlap by means of two appropriately coated plates 112 and 114. *Id.* at 33:48–51. Plate 112 transmits the light from 110 and reflects the light from 111. *Id.* at 33:51–52. Plate 114 transmits the light from 110 and 111 and reflects the light from 113. *Id.* at 33:52–53. In a preferred embodiment, one light source is switched on at a time, and an image is taken of the object for each of the light sources individually. *Id.* at 33:53–60. The color of the surface of the object is then determined based on the amplitude signal for each color in the captured images. *Id.* at 33:64–67.

Figure 3B, reproduced below, shows a schematic presentation of an example embodiment of a pattern. *Id.* at 26:23–25.

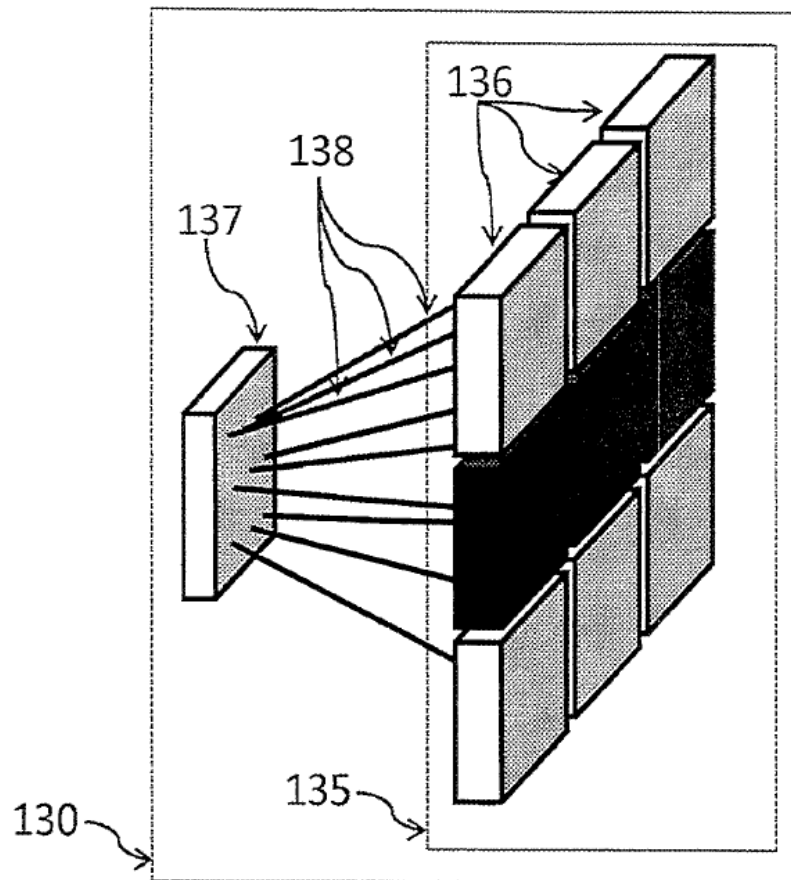


Fig. 3B

Figure 3B, reproduced above, shows a schematic presentation of an example embodiment of a pattern. *Id.* at 26:23–25.

Referring to Figure 3B, an embodiment of a pattern generation means is shown having the structure of “segmented light source 135, preferably a segmented LED,” in which “the LED surface is imaged onto the object under investigation.” *Id.* at 28:15–17. The ’146 patent discloses that “the individual LED segments 136 are turned on and off in a fashion to provide a known time-varying pattern on the object.” *Id.* at 28:17–19.

C. Challenged Claims

Petitioner challenges claims 1–6, 8–13, 15, 20–27, and 29. Pet. 1. Claims 1 and 21 are independent claims. Claims 1 and 21 are reproduced below:

1. An intraoral scanner for determining the 3D geometry and color of at least a part of the surface of an object in an oral cavity, the intraoral scanner comprising:
 - at least one camera accommodating an array of sensor elements;
 - a pattern generator configured to generate, using a light source, a probe light with a plurality of configurations in the form of a time-varying illumination pattern;
 - an optical system for transmitting the probe light towards the object along an optical path thereby illuminating at least a part of the object with the time-varying illumination pattern, and for transmitting at least a part of the light returned from the object to the at least one camera to form a plurality of 2D images, wherein the 3D geometry is determined based on the plurality of 2D images and the time-varying illumination pattern;
 - a tip configured to be inserted into the oral cavity; and
 - a hardware processor configured to:
 - selectively switch a color of the probe light, thereby illuminating the object with different colors at different times;
 - record different images by the at least one camera at the different times, thereby recording images of the object with the different colors; and
 - combine the different colors from the different images, thereby obtaining the color of the surface of the object,wherein the intraoral scanner is wireless, and wherein the at least one camera is a high-speed camera.
21. A method for determining the 3D geometry and color of at least a part of the surface of an object in an oral cavity, said method comprising the steps of:
 - using a light source and a pattern generator to generate a probe light with a plurality of configurations in the form of a time-varying illumination pattern;
 - transmitting the probe light, through a tip of intraoral scanner inserted into the oral cavity, towards the object along an optical path, thereby illuminating at least a part of the object with the time-varying illumination pattern;

transmitting at least a part of the light returned from the object to at least one camera accommodating an array of sensor elements to form a plurality of 2D images, wherein the 3D geometry is determined based on the plurality of 2D images and the time-varying illumination pattern; selectively switching a color of the probe light, thereby illuminating the object with different colors at different times; recording different images by the at least one camera at the different times, thereby recording images of the object with the different colors; combining the different colors from the different images to obtain the color of the surface of the object; and wirelessly transmitting the data for the 3D geometry.

Ex. 1001, 37:24–52, 38:60–39:17.

D. Alleged Grounds of Unpatentability

Petitioner asserts the following grounds of unpatentability:

References	35 U.S.C. §	Claims Challenged
Babayoff, ¹ Zhang, ² and Knighton, ³	103	21, 23–27, and 29
Babayoff, Zhang, Knighton, and Hanson ⁴	103	1, 3–6, 8–13, 15, 20, and 22

¹ U.S. Patent Application No. 2008/0024768 A1, published Jan. 31, 2008 (Ex. 1005) (“Babayoff”).

² L. Zhang and S. Nayar, “*Projection defocus analysis for scene capture and image display*,” ACM Trans. Graph. 25, 907–915 (2006) (Ex. 1011) (“Zhang”).

³ U.S. Patent Application No. 2005/0237581 A1, published Oct. 27, 2005 (Ex. 1007) (“Knighton”).

⁴ U.S. Patent Application No. 2003/0043089 A1, published Mar. 6, 2003 (Ex. 1008) (“Hanson”).

Babayoff, Zhang, Knighton, Hanson, and Gandyra ⁵	103	2
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Pet. 1–2. In addition to the references listed above, Petitioner relies on the Declarations of Mohit Gupta, Ph.D. (Ex. 1002) and James L. Mullins, Ph.D. (Ex. 1012). *See, e.g.*, Pet. 2, 13.

II. ANALYSIS

A. Claim Construction

For petitions such as this one, filed after November 13, 2018, we apply the same claim construction standard “used in the federal courts, in other words, the claim construction standard that would be used to construe the claim in a civil action under 35 U.S.C. [§] 282(b),” which is articulated in *Phillips v. AWH Corp.*, 415 F.3d 1303 (Fed. Cir. 2005) (en banc). 83 Fed. Reg. 51,340, 51,358 (Oct. 11, 2018) (amending 37 C.F.R. § 42.100(b) effective November 13, 2018) (now codified at 37 C.F.R. § 42.100(b) (2019)). Under the *Phillips* standard, the “words of a claim are generally given their ordinary and customary meaning,” which is “the meaning that the term would have to a person of ordinary skill in the art in question at the time of the invention, i.e., as of the effective filing date of the patent application.” *Phillips*, 415 F.3d at 1312–13.

According to Petitioner, “[n]o terms in the challenged claims have been construed in any civil action.” Pet. 14. Petitioner does not propose any claim constructions for any specific terms, but generally advocates that “all claim terms should be given their ordinary and customary meaning.” *Id.*

⁵ U.S. Patent Application No. 2009/0087050 A1, published Apr. 2, 2009 (Ex. 1009) (“Gandyra”).

According to Patent Owner, “Petitioner is not taking consistent positions between this proceeding and the parallel district court proceeding” where “Petitioner has alleged constructions and indefiniteness in the parallel proceeding.” Prelim. Resp. 5–9 (citing Ex. 2005).

We do not need to construe any terms expressly to reach our decision. *See Realtime Data LLC v. Iancu*, 912 F.3d 1368, 1375 (Fed. Cir. 2019) (“The Board is required to construe ‘only those terms . . . that are in controversy, and only to the extent necessary to resolve the controversy.’” (quoting *Vivid Techs., Inc. v. Am. Sci. & Eng’g, Inc.*, 200 F.3d 795, 803 (Fed. Cir. 1999))).

B. Alleged Obviousness

In *Graham v. John Deere Co. of Kansas City*, 383 U.S. 1 (1966), the Supreme Court set out a framework for assessing obviousness under § 103 that requires consideration of four factors: (1) the “level of ordinary skill in the pertinent art,” (2) the “scope and content of the prior art,” (3) the “differences between the prior art and the claims at issue,” and (4) “secondary considerations” of non-obviousness such as “commercial success, long-felt but unsolved needs, failure of others, etc.” *Id.* at 17–18. “While the sequence of these questions might be reordered in any particular case,” *KSR Int’l Co. v. Teleflex Inc.*, 550 U.S. 398, 407 (2007), the Federal Circuit has “repeatedly emphasized that an obviousness inquiry requires examination of all four *Graham* factors and that an obviousness determination can be made only after consideration of each factor.” *Nike, Inc. v. Adidas AG*, 812 F.3d 1326, 1335 (Fed. Cir. 2016).

We note that, with respect to the fourth *Graham* factor, the current record in this proceeding does not include any argument or evidence directed

to secondary considerations of nonobviousness. The analysis below addresses the first three *Graham* factors.

C. Level of Ordinary Skill in the Art

In determining the level of skill in the art, we consider the type of problems encountered in the art, the prior art solutions to those problems, the rapidity with which innovations are made, the sophistication of the technology, and the educational level of active workers in the field. *Custom Accessories, Inc. v. Jeffrey-Allan Indus. Inc.*, 807 F.2d 955, 962 (Fed. Cir. 1986); *Orthopedic Equip. Co. v. U.S.*, 702 F.2d 1005, 1011 (Fed. Cir. 1983).

Petitioner contends that an ordinarily skilled artisan at the time of the invention of the '146 patent would have had the following education and experience:

a person of ordinary skill in the art ("POSA") as of the effective filing date of the '146 patent would have had a bachelor's degree in Computer Engineering, Computer Science, Electrical Engineering, Physics, or an equivalent field, as well as at least one or two years of design experience, or alternatively, at least five years of comparable industry experience. In particular, a POSA would have had experience with and knowledge of 3D imaging systems and 3D modeling techniques. Ex. 1002, ¶25.

Pet. 13–14. Patent Owner does not dispute this level of skill. For purposes of this Decision, we adopt Petitioner's proposal, which comports with the teachings of the '146 patent and the asserted prior art.

D. Prior Art References

1. Babayoff (Ex. 1005)

Babayoff's invention relates to optical scanners for providing a digital representation of three-dimensional objects, including color, particularly in

the surveying of the intraoral cavity. *Id.* ¶ 1. Babayoff is aimed at the imaging of a three-dimensional topology of a teeth segment, including where one or more teeth are missing, to allow the subsequent design and manufacture of crowns, bridges dental restorations, or dental filings. *Id.* ¶ 9.

Figure 1, reproduced below, shows the main elements of preferred embodiments of an optical scanner. *Id.* ¶ 115.

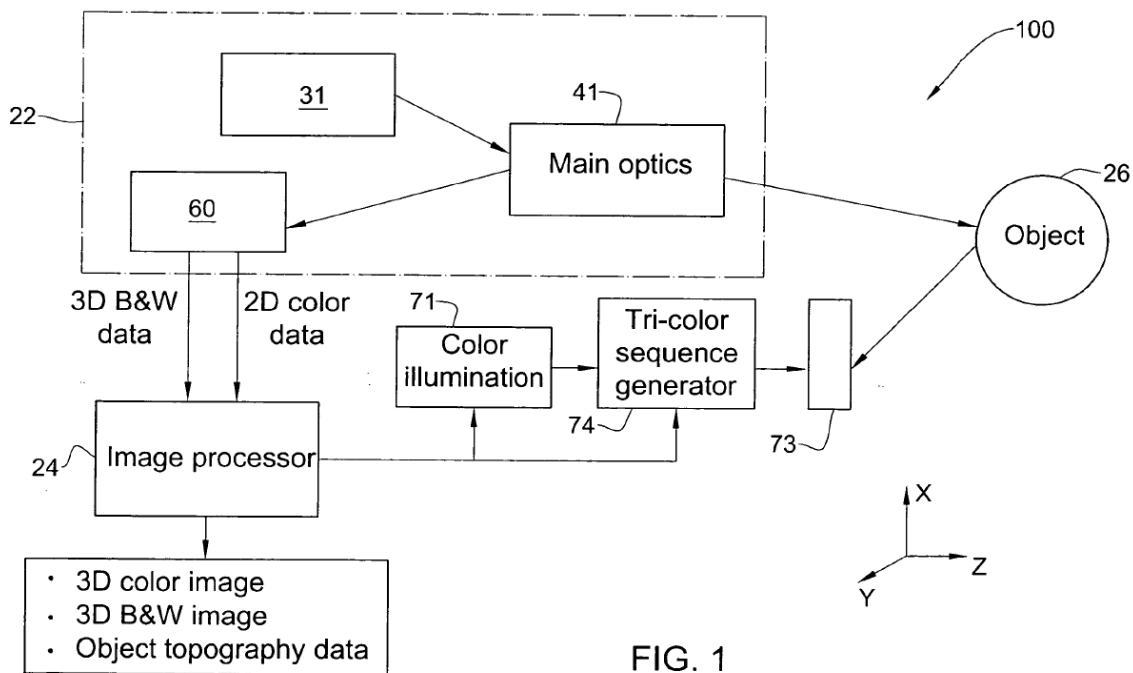


FIG. 1

Figure 1, reproduced above, shows the main elements of preferred embodiments of an optical scanner. *Id.* ¶ 115.

Referring to Figure 1, “device 100 comprises a main illumination source 31 for illuminating the object of interest 26, typically a part of the intraoral cavity, and is optically coupled to main optics 41 to provide depth Z values for an array range of X-Y points (according to a known frame of reference) along the surface of the object 26.” *Id.* ¶ 129. Detection optics 60 receives image data from main optics 41 and image processor 24 determines the depth Z values for each X-Y point illuminated on object 26

based on this image data to derive a manipulable 3-D numerical entity E comprising the surface coordinates of object 26. *Id.* Device 100 further comprises color illuminating means, such as tri-color sequence generator 74, for selectively illuminating object 26 with green, red, and blue colors. *Id.* ¶ 130.

Figure 4A, reproduced below, schematically illustrates the main elements of the scanner used for providing a three dimensional monochrome entity. *Id.* ¶ 119.

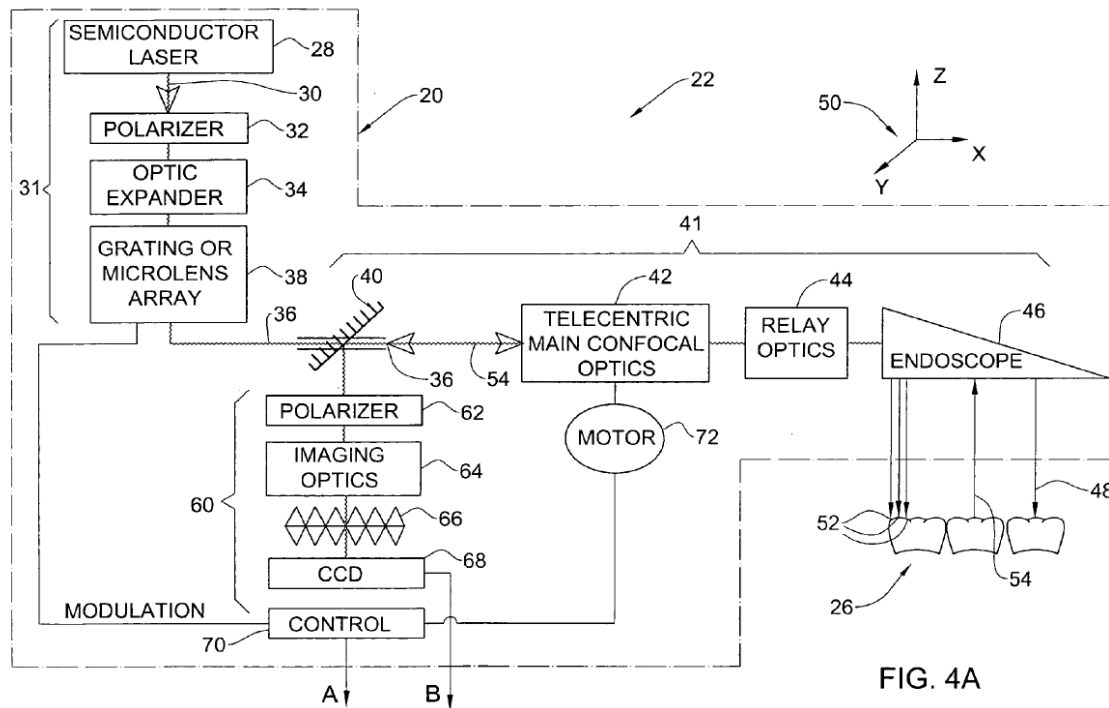


FIG. 4A

Figure 4A, reproduced above, schematically illustrates the main elements of the scanner used for providing a three dimensional monochrome entity. *Id.* ¶ 119.

Referring to Figure 4A, main optics 41, main illumination source 31, detection optics 60 are illustrated by way of a block diagram of a system for confocal imaging of a three dimensional structure. *Id.* ¶ 134. Motor 72 is linked to telecentric confocal optics 42 for changing the relative location of

the focal plane of the optics 42 along the Z-axis. *Id.* ¶ 142. Control unit 70 induces motor 72 to displace the optical element 42 to change the focal plane location and then, after receipt of a feedback that the location has changed, control module 70 will induce laser 28 to generate a light pulse. *Id.* At the same time, it will synchronize image-capturing module 80 to grab data representative of the light intensity from each of the sensing elements. *Id.* In subsequent sequences, the focal plane will change in the same manner and the data capturing will continue over a wide focal range of optics 44. *Id.*

2. *Zhang (Ex. 1011)*

Zhang's disclosure relates to a coaxial projector-camera system said to provide increased accuracy near depth discontinuities in comparison to most depth recovery methods. *Id.*, Abstract. Zhang discloses a method of using the coaxial projector-camera system to "project a shifting pattern over the scene and compute depth at each pixel using just its intensity variation over time." *Id.* at 908.

Figure 1, reproduced below, shows the principle of depth from projection defocus.

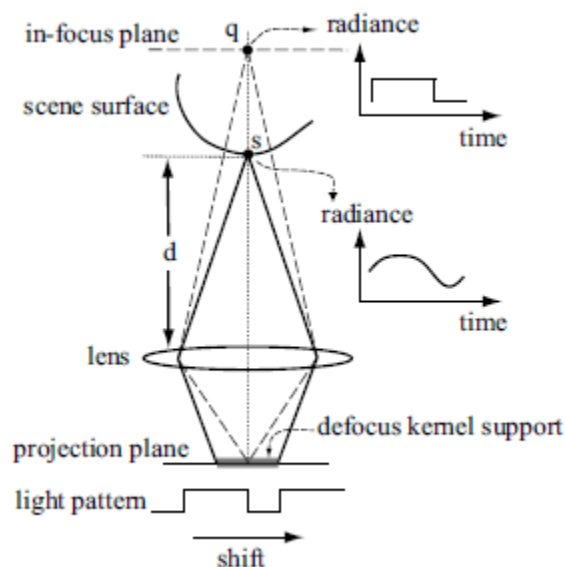


Figure 1, reproduced above, shows the principle of depth from projection defocus. *Id.* at 908.

As shown above, a light pattern is shifted by translating the pattern to the right. *Id.* At “q” in the in-focus plane, the radiance that has a step-like behavior that is similar to the light pattern. *Id.* In contrast, when the light hits the scene surface at “s” from a distance “d,” the radiance provides a curved behavior. *Id.*

Figure 2(b), reproduced below, shows an illumination pattern that is shifted across the scene to independently measure depth at each camera pixel.



Figure 2(b), reproduced above, shows an illumination pattern that is shifted across the scene to independently measure depth at each camera pixel. *Id.*

Zhang discloses that the projection defocus system uses “temporal blur for depth recovery,” which is obtained at scanned object points that are at different distances to the z direction fixed-position projector. *Id.* at 909.

3. *Knighton (Ex. 1007)*

Knighton’s invention relates to a hand-held scanner for “scanning three dimensional objects to generate a three dimensional representation of the objects.” *Id.*, Abstract, ¶ 2. Knighton discloses that the hand-held

device can include a communications device and an antenna for wirelessly transmitting the data for the 3D geometry. *Id.* ¶ 33.

Figure 1, reproduced below, shows an embodiment of a scanning device. *Id.* ¶ 9.

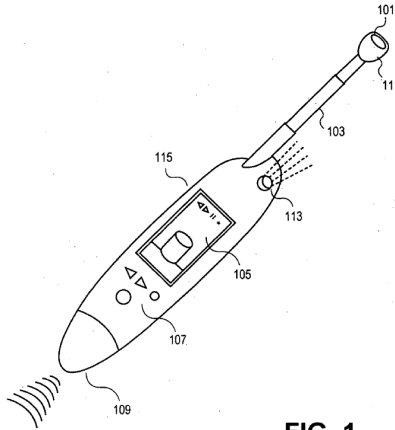


FIG. 1

Figure 1, reproduced above, shows an embodiment of a scanning device. *Id.* ¶ 9.

Referring to Figure 1, main housing 115 may include a wireless communication device 109. *Id.* ¶ 33. Wireless communication device 109 may be a radio frequency (RF) transmitter, cellular device, IEEE 802.11 device or similar transmitter, which may support the Bluetooth standard, TCP/IP communication and similar communication standards. *Id.*

4. *Hanson (Ex. 1008)*

Hanson's invention relates to an imaging system in which analog to digital conversion is facilitated at high speeds. *Id.* ¶ 2. Petitioner contends Hanson's "image sensor can have multiple A/D converters per line of pixels in a pixel array to increase the speed of the image sensor." Pet. 11 (citing Ex. 1008 ¶¶ 17, 28, 30–37, Figs. 3, 5, and 6).

Figure 6, reproduced below, shows a block diagram of a pixel array and analog processing and digitization system. Ex. 1008 ¶ 24.

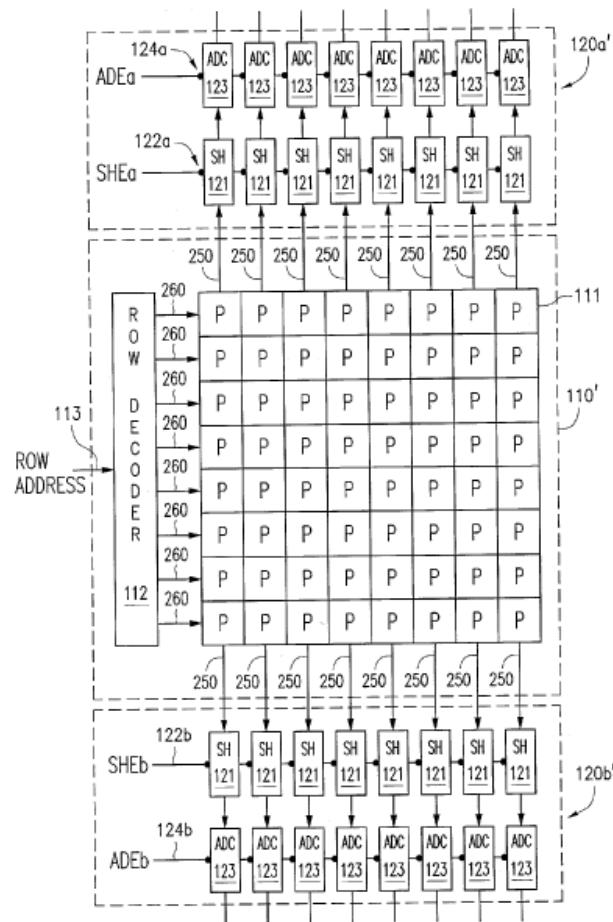


FIG. 6

Figure 6, reproduced above, shows a block diagram of a pixel array and analog processing and digitization system. Ex. 1008 ¶ 24.

Referring to Figure 6, Petitioner contends that Hanson’s “multiple A/D converters 123 allows for the image sensor to be ‘high speed.’” Pet. 12 (citing Ex. 1008 ¶¶ 17, 28, 30–37).

5. *Gandyra* (Ex. 1009)

Gandrya’s invention relates to a scanner used for scanning a tooth, a plurality of teeth, or a dental cast. *Id.*, Abstract. Petitioner contends that Gandrya “teaches the use of a time-variable illumination pattern for the scanning.” Pet. 12 (citing Ex. 1009, Abstract, ¶¶ 1, 30, 38, Fig. 1).

Figure 1, reproduced below, shows a scanner for scanning a group of teeth in a schematic view. Ex. 1009 ¶ 27.

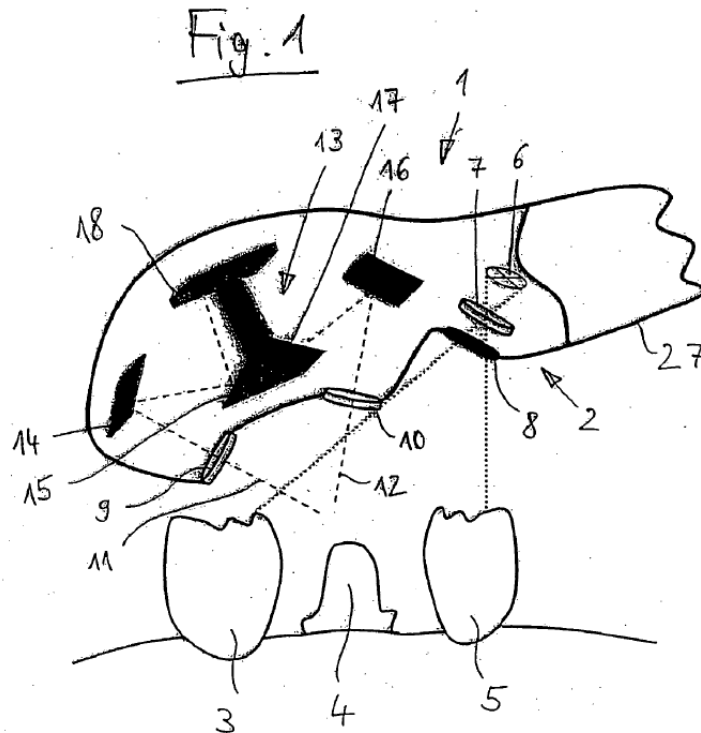


Figure 1, reproduced above, shows a scanner for scanning a group of teeth in a schematic view. Ex. 1009 ¶ 27.

As shown in Figure 1, scanner 1, which includes projector 2 for projecting a pattern onto the teeth 3, 4, 5. *Id.* ¶ 30. Projector 2 comprises light source 6, pattern transparency 7, and projection optics 8. *Id.* Instead of pattern transparency 7, a transmitted-light LCD can also be used, which can be activated for forming a pattern. *Id.* The pattern can be a time-constant, time-variable, or time-sequential pattern. *Id.* ¶ 38.

E. Ground 1 - Obviousness Based on Babayoff, Zhang, and Knighton

Petitioner asserts that each of claims 21, 23–27, and 29 of the '146 patent would have been obvious over the proposed combination of Babayoff, Zhang, and Knighton. Pet. 14–48.

For the reasons discussed below, we are not persuaded that Petitioner has demonstrated a reasonable likelihood of prevailing on this challenge.

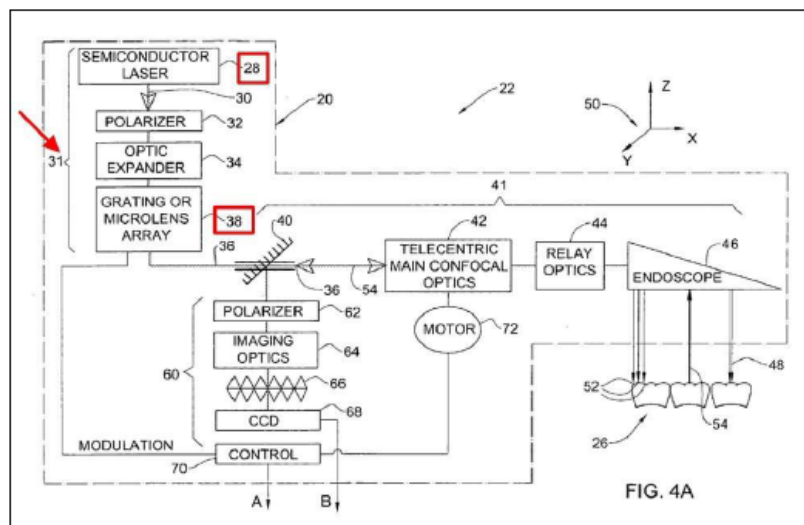
1. Independent Claim 21

Claim 21 recites, in part, “using a light source and a pattern generator to generate a probe light with a plurality of configurations in the form of a time-varying illumination pattern.” Ex. 1001, 38:63–65.

a. Petitioner’s Contentions

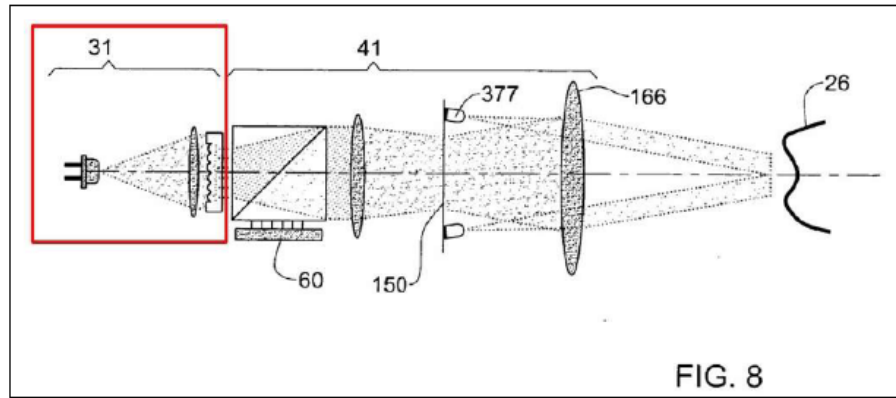
Referring to Figures 4A and 8. Petitioner asserts that Babayoff teaches a light source, e.g., illumination unit 31 and semiconductor laser unit 28, and a pattern generator, e.g., module 38, that is part of illumination source 31. Pet. 17–18. Petitioner further contends that “module 38 . . . provides the incident light beams 36 that become the incident light beams 48.” *Id.* at 18.

To illustrate, Petitioner provides annotated versions of Babayoff Figures 4A and 8, reproduced below.



Petitioner’s annotated version of Babayoff Figure 4A showing an optical device (22) comprising an illumination source (31), identified by a red arrow, that comprises “SEMICONDUCTOR LASER UNIT” 28 (outlined in red) and “a module 38, which

may, for example, be a grating or a micro lens array” (outlined in red). Pet. 19; *see* Ex. 1005 ¶ 135.



Petitioner’s annotated version of Babayoff Figure 8 showing a device comprising a main illumination source 31 (outlined in red) optically coupled to main optics 41 illuminating object 26. Pet. 19; *see* Ex. 1005 ¶ 129.

Petitioner asserts that “Babayoff discloses a method for determining a Z or depth coordinate for each location on the object 26 for the 3D representation.” Pet. 19–20 (citing Ex. 1005 ¶¶ 10–15, 139–140). The technique involves using “motor 72, that is linked to telecentric confocal optics 42,” to “displace[] the optical element 42 to change the focal plane location [of the optics 42 along the Z-axis] and then an image is captured by the image-capturing module 80 for that focal plane location.” *Id.* at 20 (citing Ex. 1005 ¶ 142), *see* Ex. 1005, Fig. 4A. Petitioner contends that “[t]his process is repeated for different focal plane locations with an image taken for each focal plane location, and the motor 72 is used to change between the focal plane locations.” *Id.* (citing Ex. 1005 ¶¶ 11, 32, 139–142). A light pattern created by the illumination source 31 is used at each focal plane position when an image is captured. *Id.* at 20 (citing Ex. 1005 ¶¶ 11, 32, 139–142, Figures 4A, 8). “Babayoff then determines the Z-axis depth

coordinate for each (X, Y) location by analyzing the light intensity at the location in the captured images.” *Id.* (citing Ex. 1005 ¶¶ 12–15, 139, 143)

Petitioner concedes that “Babayoff does not explicitly disclose that the light pattern is time-varying.” Pet. 20. And, instead, relies on Zhang’s teaching of a projection defocus method in which a striped illumination pattern is shifted across the object being imaged to measure depth. *Id.* at 21 (citing Ex. 1011, 907–910, 914–915, Figs. 1, 2).

Petitioner argues that it would have been obvious to a person of ordinary skill in the art (POSITA) to replace Babayoff’s illumination source 31 with Zhang’s Digital Light Processing (DLP) or Liquid Crystal Display (LCD) projector to create a time-varying illumination pattern and to determine depth using Zhang’s method. *Id.* at 22. According to Petitioner, “Babayoff employs at least *partially a camera defocus method* to determine depth information from the captured 2D images.” *Id.* at 15. Petitioner further contends that “Zhang provides the motivation for using a projection defocus method with a shifting illumination pattern as an alternative to a camera defocus method” because “the projection defocus method for obtaining 3D shape information is more accurate near depth discontinuities, is simple, has lower computational complexity, is not subject to local minima, and is independent of scene geometry and texture, which makes it superior to camera defocus for depth estimation.” *Id.* at 22–23 (citing Ex. 1011, 907–908, 914); *see also* Ex. 1002 ¶ 57.

b. Patent Owner’s Contentions

In its Preliminary Response, Patent Owner makes several arguments including “[t]he premise upon which Petitioner bases its motivation argument is incorrect.” Prelim. Resp. 23. In particular, Patent Owner points

out that Petitioner and Petitioner's expert argue incorrectly that Babayoff uses a camera defocus method. *Id.* Patent Owner asserts that Babayoff teaches a confocal focusing method; not a camera defocus method. *Id.* As such, Patent Owner contends that Petitioner's assertions that a POSITA would have replaced Babayoff's illumination source with Zhang's projection defocus system's DLP and LCD is unsupported by the record.

c. Discussion

We agree with Patent Owner that Petitioner has not sufficiently articulated an adequate rationale to combine the references to arrive at the challenged claim 21. "[T]here must be some articulated reasoning with some rational underpinning to support the legal conclusion of obviousness." *In re Kahn*, 441 F.3d 977, 988 (Fed. Cir. 2006); *see also KSR Int'l Co. v. Teleflex Inc.*, 550 U.S. 398, 127 S.Ct. 1727, 1741, 167 L.Ed.2d 705 (2007) ("To facilitate review, this analysis should be made explicit.")

For example, Petitioner states, without explanation, that "the modification to the Babayoff device to include a DLP or LCD projector as taught by Zhang in place of the illumination source 31 would have been *straightforward* for a POSA to implement because it is just the substitution of one known element for another." Pet. 23 (citing Ex. 1002 ¶ 58). (emphasis added). The evidence in support of the "straightforward" nature of replacing Babayoff's illumination source 31 with Zhang's DLP or LCD projector is limited to Dr. Gupta's testimony which simply repeats, without factual support, that "the modification to the Babayoff device to include a DLP or LCD projector as taught by Zhang in place of the illumination source 31 would have been straightforward for a POSA to implement

because it is just the substitution of one known element for another.” Ex. 1002 ¶ 58.

Moreover, the differences between the Babayoff and Zhang systems are not sufficiently addressed.

While Babayoff does not mention a defocus method, the reference explicitly teaches a “confocal focusing method.” Ex. 1005 ¶¶ 10–15. For example, Babayoff’s Figure 4A, reproduced below, schematically illustrates the main elements of the scanner used for providing a three dimensional monochrome entity. *Id.* ¶ 118.

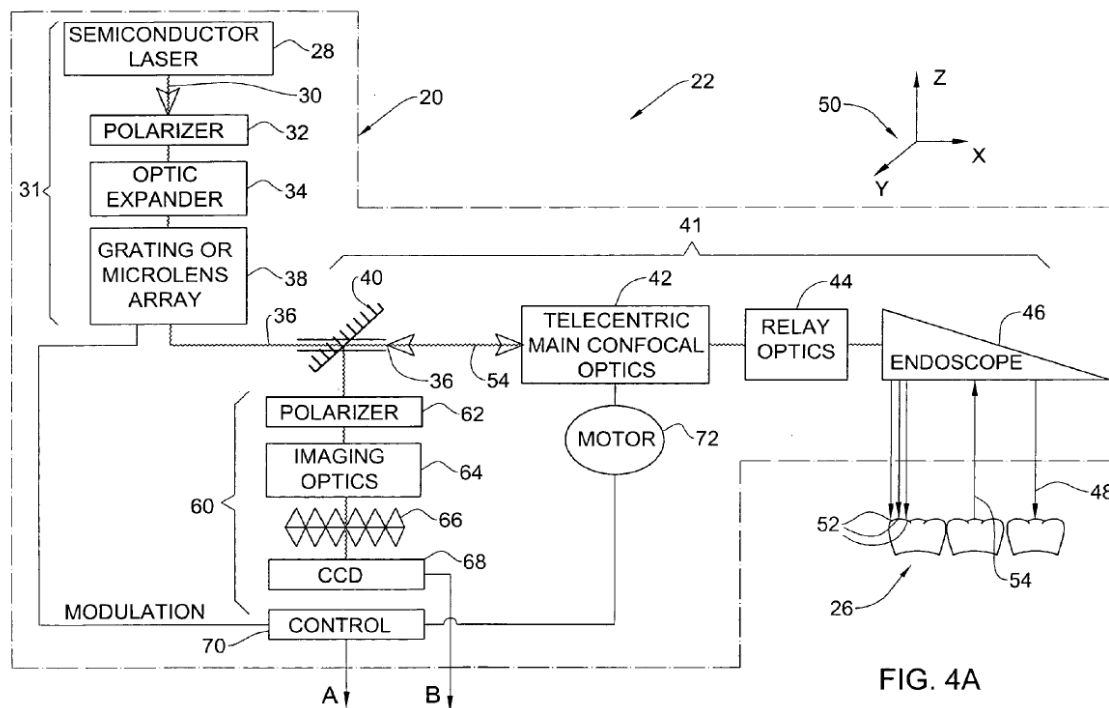


Figure 4A, reproduced above, schematically illustrates the main elements of the scanner used for providing a three dimensional monochrome entity. *Id.* ¶ 118.

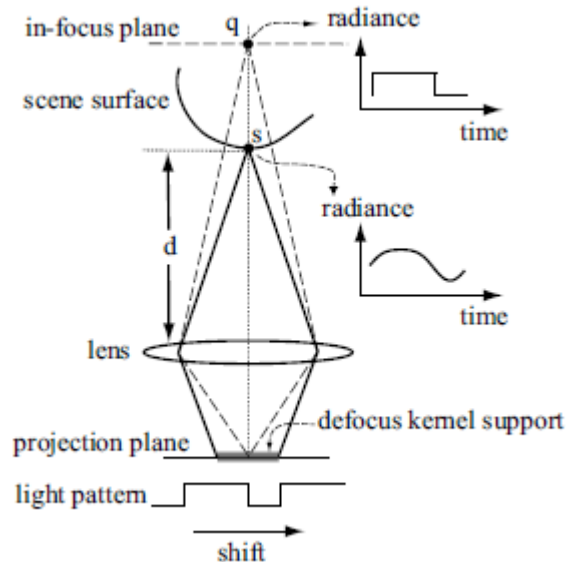
Included in Figure 4A, Babayoff teaches that motor 72 is linked to *telecentric confocal optics* 42 for changing the relative location of the focal

plane of the optics 42 along the Z-axis. *Id.* ¶ 142. Control unit 70 induces motor 72 to displace the optical element 42 to change the focal plane location and then, after receipt of a feedback that the location has changed, control module 70 will induce laser 28 to generate a light pulse. *Id.* Image-capturing module 80 grabs data representative of the light intensity from each of the sensing elements. *Id.* Then, as Petitioner correctly points out, Babayoff “determines the Z-axis depth coordinate for each (X, Y) location by analyzing the light intensity at the location in the captured images.” Pet. 20 (citing Ex. 1005 ¶¶ 12–15, 139, 143).

Missing from Babayoff’s disclosure and the Petition, however, is an explanation of how the confocal focusing method described in Babayoff is “*at least partially camera defocus method* for determining the depth coordinates.” See Pet. 21 (emphasis added). Rather, as discussed above, Babayoff teaches a *confocal focusing* method where light intensity is measured over a series of different focal plane locations to determine surface topology. See Ex. 1005 ¶¶ 10–15.

In contrast, Zhang teaches a projection defocus analysis for scene capture and image display. Ex. 1011, 1. Zhang teaches “a method called temporal defocus analysis that estimates depth at each camera pixel, independently, without using information from neighboring pixels (Section 3).” *Id.* Zhang’s method uses a projector system to “project a shifting pattern over the scene and compute depth at each pixel using just its intensity variation over time.” *Id.* at 908.

Figure 1, reproduced below, shows the principle of depth from



projection defocus.

Figure 1, reproduced above, shows the principle of depth from projection defocus. *Id.* at 907.

According to Zhang, “[p]oints at different distances to the projector lens exhibit different amounts of blur in their temporal radiance profile as a periodic illumination pattern is shifted across the scene.” *Id.* At point “q” that is in focus, the temporal radiance profile has a step-like behavior that is similar to the periodic illumination pattern. *Id.* In contrast, at point “s,” that is out of focus, the radiance provides a curved behavior. *Id.* Zhang teaches that “[a]s the pattern is shifted, points at different distances to the projector exhibit different amounts of blur in their temporal radiance profile, as illustrated in Figure 1. We use this temporal blur for depth recovery.” *Id.* at 909.

Dr. Gupta’s testimony does not help in this regard. In paragraph 57 of this declaration, Dr. Gupta’s testimony mirrors that provided in the Petition. Dr. Gupta testifies that

Zhang provides the motivation for using a projection defocus method with a shifting illumination pattern *as an alternative to a camera focus/defocus method* . . . [because] the projection defocus method for obtaining 3D shape information is more accurate near depth discontinuities, is simple, has lower computational complexity, is not subject to local minima, and is independent of scene geometry and texture, which makes it superior to camera defocus for depth estimation. Ex. 1002 ¶ 57 (citing Ex. 1011, 907–908, 914).

Nonetheless, even assuming that projector defocus methods may have advantages over camera defocus methods, Dr. Gupta does not explain how Babayoff teaches camera defocus methods. Instead, Dr. Gupta acknowledges that Babayoff uses confocal focusing techniques. For example, Dr. Gupta testifies that

[t]he scanner [shown in Figure 8] is a *confocal* scanner, varies the position of a focal plane for the scanner, and obtains images of the object at the different focal plane positions using an image sensor. . . . The scanner then uses images from the focal plane positions to determine for each pixel the focal plane for which the pixel is most in-focus and uses that information to determine the 3D surface information for the pixel.

Ex. 1002 ¶ 36 (citing Ex. 1005 ¶¶ 10–11, 13–15, 32, 34, 142) (emphasis added).

For these reasons, we find Petitioner’s rationale for combining Babayoff with Zhang to be insufficiently developed to support its obviousness contentions for claim 21. Thus, we determine that Petitioner has not established a reasonable likelihood that it would prevail in showing that the subject matter of claim 21 would have been obvious over the combination of Babayoff, Zhang, and Knighton.

d. Dependent Claims 23–27 and 29

Claims 23–27 and 29 depend from independent claim 21. Petitioner relies on the same rationale discussed above for the combination of Babayoff, Zhang, and Knighton. *See* Pet. 14–48.

For the same reasons discussed above, we determine that Petitioner has not established a reasonable likelihood of prevailing in its contention that each of claims 23–27 and 29 would have been obvious over the combination of Babayoff, Zhang, and Knighton.

2. Conclusion

Accordingly, on this record, we determine that Petitioner has not shown a sufficient basis for instituting trial on the ground that claims 21, 23–27, and 29 would have been obvious over the asserted combination of Babayoff, Zhang, and Knighton.

F. Ground 2 - Obviousness Based on Babayoff, Zhang, Knighton, and Hanson

Petitioner asserts that each of claims 1, 3–6, 8–13, 15, 20, and 22 of the '146 patent would have been obvious over Babayoff, Zhang, Knighton, and Hanson. Pet. 49–70.

Petitioner relies on the same rationale discussed above for the combination of Babayoff, Zhang, and Knighton. Pet. 49 (“The motivation to combine Babayoff, Zhang, and Knighton was discussed above under Ground 1 and also applies to Ground 2.”)

For the same reasons discussed above, we determine that Petitioner has not established a reasonable likelihood of prevailing in its contention that each of claims 1, 3–6, 8–13, 15, 20, and 22 would have been obvious over the combination of Babayoff, Zhang, Knighton, and Hanson.

*G. Ground 3 - Obviousness Based on Babayoff, Zhang, Knighton,
Hanson, and Gandyra*

Petitioner asserts that claim 2 of the '146 patent would have been obvious over Babayoff, Zhang, Knighton, Hanson, and Gandyra. Pet. 71–72.

For the same reasons discussed above, we determine that Petitioner has not established a reasonable likelihood of prevailing in its contention that claim 2 would have been obvious over the combination of Babayoff, Zhang, Knighton, Hanson, and Gandyra.

III. CONCLUSION

For the foregoing reasons, we deny institution of *inter partes* review of the '146 patent.

IV. ORDER

Upon consideration of the record before us, it is:

ORDERED that the Petition is denied as to all challenged claims of the '146 patent, and no *inter partes* review is instituted.

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