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Paper 8
Date: July 3, 2023

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

DENTAL IMAGING TECHNOLOGIES CORPORATION,
Petitioner,

v.

3SHAPE A/S,
Patent Owner.

IPR2023-00411
Patent 11,368,667 B2

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

LORIN, *Administrative Patent Judge*.

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

I. INTRODUCTION

A. Background

Dental Imaging Technologies Corporation ("Petitioner") filed a Petition (Paper 2, "Pet.") and a corrected Petition (Paper 3, "Corr. Pet."[1]) requesting *inter partes* review of claims 1–8, 12–22, and 26–29 of U.S. Patent No. 11,368,667 B2 (Ex. 1001, "the '667 patent"). 3Shape A/S ("Patent Owner") filed a Preliminary Response (Paper 6, "Prelim. Resp.").

We have authority under 35 U.S.C. § 314, which provides that an *inter partes* review may not be instituted unless the information presented in the Petition and the Preliminary Response shows that "there is a reasonable likelihood that the petitioner would prevail with respect to at least 1 of the claims challenged in the petition." 35 U.S.C. § 314(a) (2018).

After considering the Petition, the Preliminary Response, and the evidence of record, we deny Petitioner's request to institute an *inter partes* review as to the challenged claims of the '667 patent on the grounds of unpatentability presented.

B. Related Proceedings

Petitioner indicates that the '667 patent is asserted in pending district court litigation styled *3Shape A/S v. Carestream Dental LLC et al.*, Civil No. 1:22-cv-01829 (N.D. Ga.). Corr. Pet. 70. Petitioner indicates that the Georgia district court litigation "was transferred from the Western District of Texas and was previously styled as *3Shape A/S v. Carestream Dental LLC*, Civil No. 6:21-cv-01110 (W.D. Tex.), filed October 26, 2021." *Id.* at 70-71.

[1] We will refer to the corrected Petition in our analysis.

Petitioner indicates that the '667 patent is also the subject of pending district court litigation in *3Shape A/S v. Medit Corporation*, Civil No. 6:22-cv-00443 (W.D. Tex.), filed May 2, 2022. Corr. Pet. 71.

Patent Owner, in its Mandatory Notices, identifies the same district court litigations as Petitioner. Paper 4, 1. Patent Owner also makes us aware of other Office proceedings involving U.S. Patent Nos. 11,076,146, 10,097,815, and 10,349,042 related to the '667 patent. *Id.* at 1-2.

C. Real Parties in Interest

Petitioner identifies "DITC" and "Carestream Dental LLC" as real parties in interest. Corr. Pet. 70. Patent Owner identifies "3SHAPE A/S" as the real party in interest. Paper 4, 1.

D. The '667 Patent (Ex. 1001)

1. Disclosure

The '667 patent, titled "Intraoral Scanning Apparatus," "relates to an apparatus and a method for optical 3D scanning of surfaces." Ex. 1001, code (54), 1:26–27. For example, one "embodiment of the invention is particularly suited for intraoral scanning, i.e. direct scanning of teeth and surrounding soft-tissue in the oral cavity." *Id.* at 1:29–32.

The '667 patent describes "providing a 3D surface registration of objects using light as a non-contact probing agent," wherein "[t]he light is provided in the form of an illumination pattern to provide a light oscillation on the object." Ex. 1001 at 3:10–14. "The variation/oscillation in the pattern may be spatial, e.g. a static checkerboard pattern, and/or it may be time varying, for example by moving a pattern across the object being scanned." *Id.* at 3:14–17.

The '667 patent discloses that "[h]andheld embodiments of the invention preferably include motion sensors such as accelerometers and/or gyros." Ex. 1001, 24:12–13. "Preferably, these motion sensors are small like microelectromechanical systems (MEMS) motion sensors" and "should preferably measure all motion in 3D, i.e., both translations and rotations for the three principal coordinate axes." *Id.* at 24:14–18. Figure 8, reproduced below, depicts a color 3D scanner according to an embodiment of the '667 patent. *Id.* at 33:50–51.

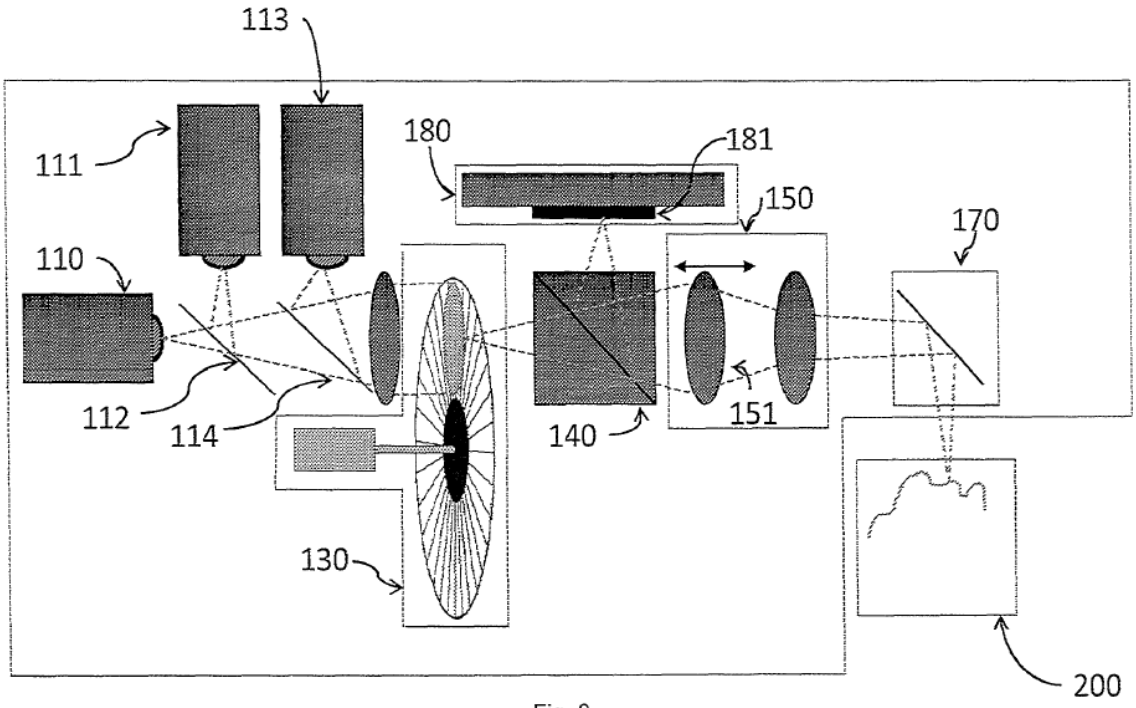


Fig. 8

Figure 8 of the '667 patent depicts a color 3D scanner for scanning an object 200. The scanner comprises three light sources 110, 111, and 113, two appropriately coated plates 112 and 114, pattern generation means 130, beam splitter 140, an optical system 150 including a focusing element 151, folding optics 170, and a camera 180 including an image sensor 181. Ex. 1001, 33:50–55; *Id.* at 27:18–31.

The '667 patent explains that "light sources 110, 111, and 113 emit red, green, and blue light" and the "light is merged together to overlap or essentially overlap." Ex. 1001, 33:51–53. "This may be achieved by means of two appropriately coated plates 112 and 114." *Id.* at 33:54–55. A color measurement is performed using sensor 181 to measure the amplitude of the time-varying pattern projected onto the probed object at a given focus position. *Id.* at 33:57–62. The '667 patent describes a preferred embodiment wherein "only one light source is switched on at the time, and the light sources are switched on after turn." *Id.* at 33:62–64. "After determining the amplitude for each light source[,] the focus position is shifted to the next position and the process is repeated." *Id.* at 33:66–34:1.

2. Claims 1—8, 12–22, and 26–29

Petitioner challenges claims 1–8, 12–22, and 26–29. Claims 1, 14, and 26 are independent claims. Claims 2–8, 12, and 13; 15–22; and 27–29 depend from claims 1, 14, and 26, respectively.

Claim 1 is reproduced below with bracketing added to assist in referring to the claim elements.

> 1. [preamble][2] A handheld 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:
> 1[a] a tip configured to be inserted into the oral cavity;
> 1[b] at least one camera accommodating an array of sensor elements;
> 1[c] 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;

[2] Petitioner's designations to reference the elements of claim 1 are set forth in brackets. Corr. Pet. 19–49. Herein we refer to the elements of claim 1 using Petitioner's designations.

1[d] an optical system configured to transmit the probe light, via the tip, towards the object along an optical path thereby illuminating at least a part of the object with the time-varying illumination pattern, and to transmit 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;

1[e] one or more motion sensors located on the intraoral scanner to measure three-dimensional motion of the intraoral scanner, wherein the intraoral scanner is wireless; and

1[f] a hardware processor, located within the wireless intraoral scanner, configured to:

1[f][1] selectively switch a color of the probe light to illuminate the object with different colors at different times; and

1[f][2] record images of the object with the different colors by recording different images by the at least one camera at the different times.

Ex. 1001, 37:27–56.

E. Asserted References and Testimonial Evidence

Petitioner relies on the following references:

Name	Reference	Ex. No.
Babayoff	U.S. Patent App. Pub. No. 2008/0024768 A1, published Jan. 31, 2008.	1005
Zhang	L. Zhang *et al.*, *Projection Defocus Analysis for Scene Capture and Image Display*, ACM SIGGRAPH 2006, July 2006, pp. 907–915.	1006
Knighton	U.S. Patent App. Pub. No. 2005/0237581 A1, published Oct. 27, 2005.	1007
Serra	U.S. Patent App. Pub. No. 2006/0020204 A1, published Jan. 26, 2006.	1008
Gandyra[3]	U.S. Patent App. Pub. No. 2009/0087050 A1, published Apr. 2, 2009.	1009

Petitioner also relies on the Declaration of Mohit Gupta, Ph.D. (Ex. 1002, "Gupta Decl.") as support for various contentions.

F. Asserted Grounds

Petitioner asserts that claims 1–8, 12–22, and 26–29 would have been unpatentable on the following grounds:

[3] Gandyra is not included in various statements of Ground I (*see, e.g.*, Pet. 1–2, 15) but included in the discussion of Ground I (*see id*. at 16, 30).

Ground	Claim(s) Challenged	35 U.S.C. §	Reference(s)/Basis
I	1–8, 13–16, 18–22, 26, 28, 29	103(a)[4]	Babayoff, Zhang, Knighton
II	12, 17, 27	103(a)	Babayoff, Zhang, Knighton, Serra

II. ANALYSIS

A. Principles of Law for Patentability

A patent claim is unpatentable under 35 U.S.C. § 103(a) if the differences between the claimed subject matter and the prior art are such that the subject matter, as a whole, "would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains." *KSR Int'l Co. v. Teleflex Inc.*, 550 U.S. 398, 406 (2007). The question of obviousness is resolved on the basis of underlying factual determinations including: (1) the scope and content of the prior art; (2) any differences between the claimed subject matter and the prior art; (3) the level of ordinary skill in the art; and, (4) when in evidence, objective evidence of nonobviousness. *Graham v. John Deere Co.*, 383 U.S. 1, 17–18 (1966).

"In an [*inter partes* review], the petitioner has the burden from the onset to show with particularity why the patent it challenges is

[4] The Leahy-Smith America Invents Act, Pub. L. No. 112–29, 125 Stat. 284 (2011) ("AIA"), amended 35 U.S.C. §§ 102 and 103. Because the challenged claims of the '667 patent have an effective filing date before the effective date of the applicable AIA amendments, we refer to the pre-AIA version of 35 U.S.C. §§ 102 and 103 throughout this Decision.

unpatentable." *Harmonic Inc. v. Avid Tech., Inc.*, 815 F.3d 1356, 1363 (Fed. Cir. 2016) (citing 35 U.S.C. § 312(a)(3) (requiring *inter partes* review petitions to identify "with particularity . . . the evidence that supports the grounds for the challenge to each claim")). This burden of persuasion does not shift to Patent Owner, except in limited circumstances not present here. *See Dynamic Drinkware, LLC v. Nat'l Graphics, Inc.*, 800 F.3d 1375, 1378 (Fed. Cir. 2015) (discussing the burden of proof in *inter partes* review).

B. Level of Ordinary Skill in the Art

Petitioner asserts that a person of ordinary skill in the art "as of the effective filing date of the '667 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." Corr. Pet. 14 (citing Ex. 1002). Petitioner also asserts that a person of ordinary skill in the art "would have had experience with and knowledge of 3D imaging systems and 3D modeling techniques." *Id.* (citing Ex. 1002 ¶ 25).

Patent Owner does not address Petitioner's characterization of a person of ordinary skill in the art at this stage of the proceeding. *See generally*, Prelim. Resp.

Petitioner's proposed definition of a person of ordinary skill in the art appears reasonable, and we adopt that definition for our analysis in this decision.

Based on the complete record now before us, we adopt Petitioner's undisputed proposal as reasonable and consistent with the prior art. *See*

Okajima v. Bourdeau, 261 F.3d 1350, 1355 (Fed. Cir. 2001) (the prior art may reflect an appropriate level of skill in the art).

C. Claim Construction

We determine that this Decision does not require construing any claim terms.

D. Overview of the Prior Art References

1. Babayoff (Ex. 1005)

Babayoff "relates to optical scanners, particularly for providing a digital representation of three-dimensional objects including color" and "finds particular application in the surveying of the intraoral cavity. Ex. 1005, ¶ 1. Babayoff describes "a device and method for determining the surface topology and color of at least a portion of a three-dimensional structure." *Id.* ¶ 9. Babayoff discloses "imaging of a three-dimensional topology of a teeth segment, optionally including such where one or more teeth are missing" which imaging "may allow the generation of data for subsequent use in design and manufacture of, for example, prosthesis of one or more teeth for incorporation into said teeth segment." *Id.* Babayoff discloses that "[t]he determination of the 3D surface topology of a portion of a three-dimensional structure is preferably carried out using a confocal focusing method." *Id.* ¶ 10. Babayoff's confocal method includes steps of (a) "providing an array of incident light beams propagating in an optical path leading through a focusing optics and a probing face" (*id.* ¶ 11), (b) "detecting intensity of returned light beams propagating from each of these spots along an optical path opposite to that of the incident light" (*id.*), (c) "repeating steps (a) and (b) a plurality of times, each time changing position of the focal plane relative to the structure" (*id.*), and (d) "for each of the

illuminated spots, determining a spot-specific position, being the position of the respective focal plane, yielding a maximum measured intensity of a respective returned light beam; and based on the determined spot-specific positions, generating data representative of the topology of said portion" (*id.* ¶ 12). Figure 1 of Babayoff is reproduced below.

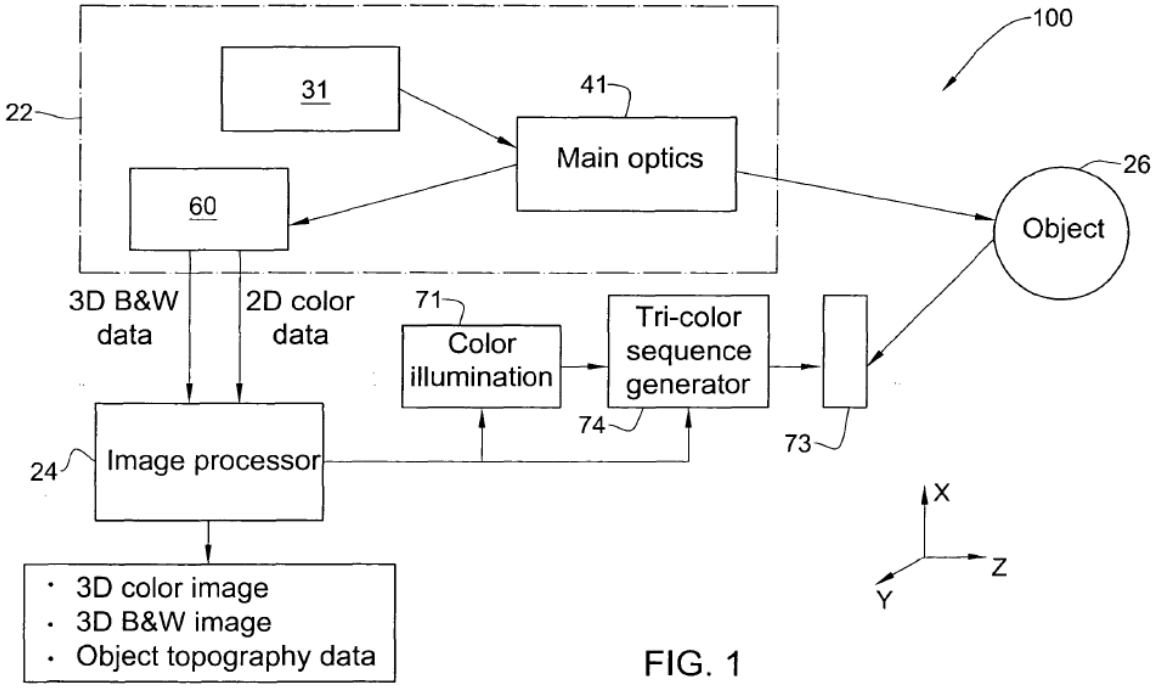


FIG. 1

Figure 1 of Babayoff illustrates the general relationship between the various elements of device 100 for imaging of object 26. Ex. 1005, ¶¶ 128–129.

Babayoff's device 100 "comprises a main illumination source 31 for illuminating the object of interest 26," which object is "typically a part of the intraoral cavity." Ex. 1005 ¶ 129. Main illumination source 31 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.* "Detection optics 60 comprises an image sensor, typically a CCD, that is preferably monochromatic to maximise the resolution of the

device, and which typically defines the X-Y frame of reference." *Id.* Babayoff discloses that "detection optics 60 receives image data from the main optics 41 and the image processor 24 determines the depth Z values for each X-Y point illuminated on the object 26 based on this image data." *Id.* Babayoff's device 100 provides "a manipulable three-dimensional numerical entity E comprising the surface coordinates of the object 26." *Id.* Device 100 "further comprises color illuminating means, such as for example a tri-color sequence generator 74." *Id.* ¶ 130. The color illuminating means selectively illuminates object 26 with "suitable colors, typically Green, Red and Blue, and for each such monochromatic illumination, a two-dimensional image of the object 26 is captured by the detection optics 60." *Id.* Babayoff discloses that "processor 24 then processes the three differently colored monochromatic images and combines the same to provide a full color 2D image of the object." *Id.* "The processor 24 aligns the 2D color image with the 3D entity previously created, and then provides color values to this entity by mapping color values to the entity at aligned X-Y points." *Id.* ¶ 131.

2. Zhang (Ex. 1006)

Zhang, titled "Projection Defocus Analysis for Scene Capture and Image Display" and describes "methods for robust scene capture and enhanced image display based on projection defocus analysis." Ex. 1006, 1 (Abstract). A projector's defocus is modeled using a linear system and the model is used to "develop a novel temporal defocus analysis method to recover depth at each camera pixel by estimating the parameters of its projection defocus kernel in frequency domain." *Id.*

Zhang explains that "video projectors have recently been used as per-pixel controllable light sources for real-time shape acquisition, for complex

appearance capture and control." Ex. 1006, 1 (citations omitted). Figure 1 of Zhang is reproduced below.

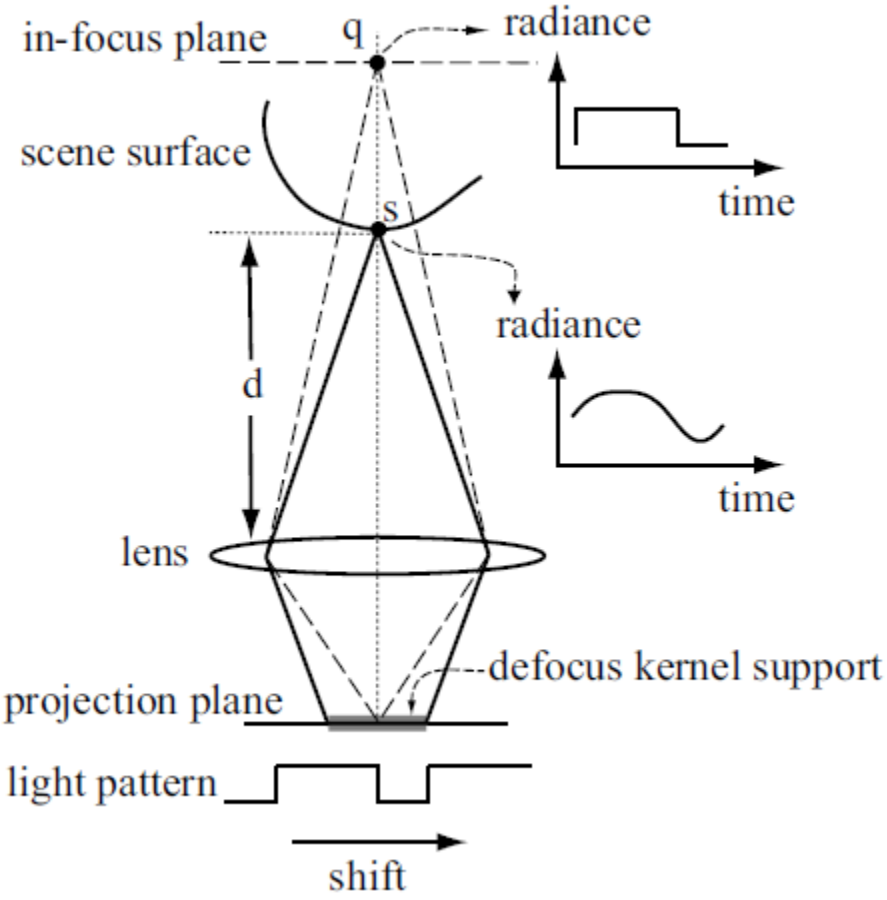
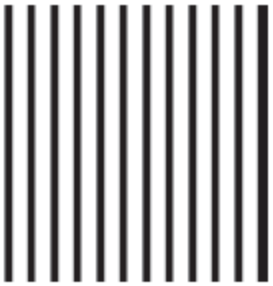


Figure 1 of Zhang illustrates the principle of depth from projection defocus. Ex. 1006, 2.

Zhang describes that, in depth from projection defocus techniques, "[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." Ex. 1006, 2. Zhang discloses that "[d]epth recovery methods based on camera focus and defocus, have the potential to recover depth at every pixel, regardless of the scene complexity and occlusions." *Id.* (citations omitted). "To resolve the focus ambiguity of

textureless surfaces, patterns can be projected to force scene texture." *Id.* Figure 2(b) of Zhang is reproduced below.



> Figure 2(b) of Zhang depicts an illumination pattern that is shifted across the scene to measure depth at each pixel, independently. Ex. 1006, 2.

Zhang explains that "unlike camera defocus, the kernel for projector defocus is *scene independent*, for most scene surfaces" and "[s]pecifically, when a 3D scene point sees the entire projector aperture, its defocus kernel depends only on its distance to the projector lens and not on its neighboring surface geometry." Ex. 1006, 2. Zhang discloses a method that comprises projecting "a shifting pattern over the scene" and computing "depth at each pixel using just its intensity variation over time." *Id.*

3. Knighton (Ex. 1007)

Knighton describes "a hand held portable scanning device" that "may be used to generate three dimensional representation of any type of object." Ex. 1007, ¶ 24. Figure 1 of Knighton is reproduced below.

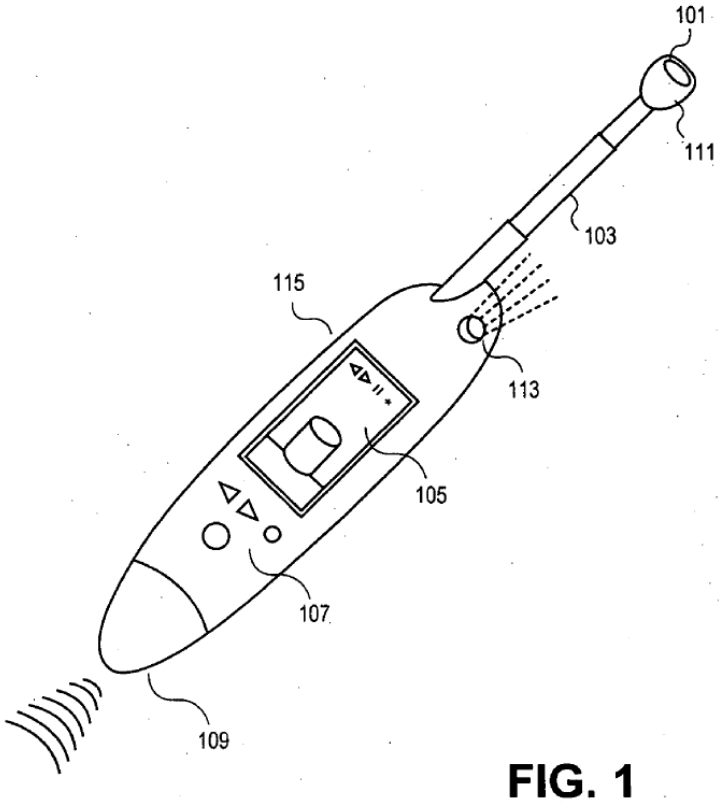


FIG. 1

Figure 1 of Knighton is a diagram of one embodiment of a scanning device. Ex. 1007, ¶ 9.

As shown in Knighton's Figure 1, a scanning device comprises a lens 101 in housing 111, a light source 113, a main housing 115, a telescoping attachment 103, a visual display 105, controls 107, and a wireless communication device 109. Ex. 1007 ¶¶ 24–33. Knighton discloses that "[w]ireless communication device 109 may be a radio frequency (RF) transmitter, cellular device, IEEE 802.11 device or similar transmitter," and "[i]n one embodiment, the wireless communication device supports the Bluetooth standard, TCP/IP communication and similar communication standards." *Id.* ¶ 33.

4. Serra (Ex. 1008)

Serra describes "[a] system and method for the imaging management of a 3D space where various substantially real-time scan images have been, or are being, acquired are presented." Ex. 1008 ¶ 12. According to Serra, "a user can visualize images of a portion of a body or object obtained from a substantially real-time scanner not just as 2D images, but as positionally and orientationally identified slices within the relevant 3D space." *Id.*

5. Gandyra (Ex. 1009)

Gandyra "relates to a scanner for scanning an object, in particular a tooth or a plurality of teeth or a dental cast, and a device for determining the 3D coordinates of an object, in particular of a tooth or a plurality of teeth or a dental cast." Ex. 1009 ¶ 1. "The scanner comprises a projector for projecting a pattern onto the object and a camera which comprises a recording optics and an image sensor, in particular a CCD sensor or a CMOS sensor." *Id.* ¶ 6.

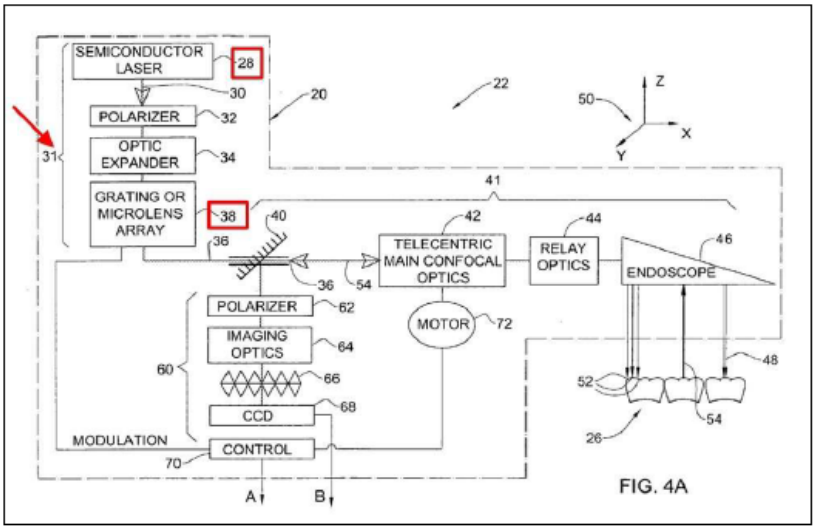
E. Ground I—Obviousness over Babayoff, Zhang, and Knighton

Petitioner challenges claims 1–8, 13–16, 18–22, 26, 28–29 as unpatentable under 35 U.S.C. § 103(a) over Babayoff, Zhang, and Knighton. Pet. 15–67.

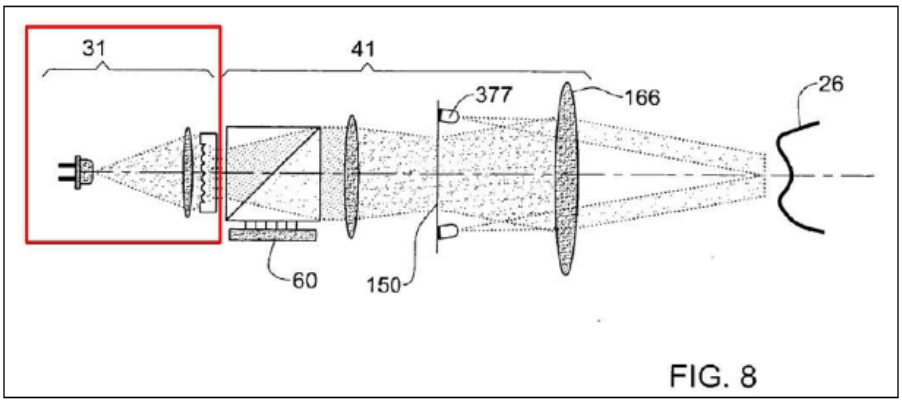
1. Claim 1

Claim 1 is drawn to "[a] handheld 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," *inter alia*, (1[c]) "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." Ex. 1001, 37:27–29, 33–35.

Petitioner contends that "[t]he ***pattern generator*** in Babayoff is [] part of the ***illumination source 31***, and is shown in FIGS. 4A and 8 as a ***grating*** or ***micro-lens array*** called the ***module 38***." Corr. Pet. 24 (citing Ex. 1005 ¶ 135, Figures 4A, 8). 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). 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. *See* Ex. 1005 ¶ 129.

Petitioner explains that "Babayoff discloses a technique for determining a Z or depth coordinate for each location on [an] object 26 for [a] 3D representation." Corr. Pet. 26 (citing Ex. 1005 ¶¶ 10–15, 139–140). The technique involves using "motor 72 that is linked to the 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*. (citing Ex. 1005 ¶ 142), *see* Fig. 4A. "This 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 27 (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*. at 26 (citing Ex. 1005 ¶¶ 12–15, 139, 143).

Petitioner indicates that "Babayoff does not explicitly disclose that the light pattern is time-varying," as 1[c] requires, relying instead on Zhang. Corr. Pet. 27–28.

Petitioner explains that Zhang exemplifies an "***illumination pattern*** as a ***stripe pattern*** that is ***shifted across the scene*** and can be formed, for example, by a Digital Light Processing (DLP) or Liquid Crystal Display (LCD) projector." Corr. Pet. 27 (citing, *inter alia*, Ex. 1006, pp. 907, 909).

The stripe pattern is shown in Figure 2(b) of Zhang. *See id*. at 28; Ex. 1006, pp. 908, Figure 2(b); reproduced in section II.D.2. According to Petitioner, "[t]he ***DLP or LCD projector*** of Zhang is the ***light source and pattern generator*** to generate the ***probe light*** with the plurality of configurations in the form of the time-varying illumination pattern." *Id*. (citing, *inter alia*, Ex. 1006, pp. 907, 909, Figure 1 (reproduced in section II.D.2.). "The ***plurality of configurations*** are the ***stripes being translated across the scene***. *Id*. The ***illumination pattern*** of Zhang that is ***shifted across the scene*** at time intervals, therefore, is a ***time-varying illumination pattern***." *Id* (citing Ex. 1006, p. 909, Fig. 2(b).

Thus, Petitioner contends that Babayoff teaches an illumination source (31) and a pattern generator creating a light pattern and Zhang teaches an illumination source and a pattern generator (a DLP or LCD projector) generating a probe light with a plurality of configurations in the form of a time-varying illumination pattern. Corr. Pet. 24–27; Ex. 1005 ¶ 138, Figures 4A, 8; Ex. 1006, pp. 907, 909, Figure 1.

Petitioner asserts that it would have been obvious to a person of ordinary skill in the art (POSA) "to ***replace the illumination source 31*** in Babayoff ***with the DLP or LCD projector of Zhang*** to create ***a time-varying illumination pattern*** . . ." and thereby reach 1[c]. Corr. Pet. 28; Ex. 1001, 33–35. Petitioner identifies the following reasons for modifying Babayoff:

- "Zhang's projection defocus method 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***. Ex. 1002, ¶69. Being independent of scene geometry is an advantage because then a wide range of scenes can be imaged." Corr. Pet. 28–29.

- Zhang . . . explain[s] that 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. 1006] 907–908, 914." Corr. Pet. 29.

Petitioner concludes that

> A POSA, therefore, would have been motivated to ***replace the illumination source 31*** in Babayoff ***with the DLP or LCD projector*** of Zhang to create a time-varying illumination pattern and to determine depth using the projection defocus method of Zhang rather than the method of Babayoff in order to obtain those advantages.

Corr. Pet. 29 (citing Ex. 1002 ¶ 70).

We have reviewed the evidence and based on the evidence we are unpersuaded that Petitioner has provided sufficient articulated reasoning, with adequate rational underpinnings, explaining why an ordinary artisan would have replaced Babayoff's illumination source 31 with Zhang's DLP or LCD projector with a reasonable expectation of successfully arriving at the claimed subject matter comprising 1[c]. "[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*, 550 U.S. at 418 ("To facilitate review, this analysis should be made explicit.")

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." Corr. Pet. 30 (citing Ex. 1002 ¶ 71) (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 ¶ 71.

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

Patent Owner argues, *inter alia*, that Babayoff describes a confocal optical system and Zhang describes a projection defocus system and "[t]here is no reason with rational underpinnings for replacing Babayoff's intraoral scanner comprising a confocal optical system with Zhang's projection defocus system." Prelim. Resp. 31. Patent Owner's characterization of the Babayoff and Zhang systems is consistent with their disclosures. *See* section II.D.1. ("Babayoff"), 2. ("Zhang").

Petitioner agrees with Patent Owner that Babayoff describes a confocal optical system and Zhang describes a projection defocus system. *See* e.g., Corr. Pet. 7 ("[t]he [Babayoff] scanner is a confocal scanner"), 28 ("the ***projection defocus method*** of Zhang").

But rather than addressing their differences, Petitioner contends that the Babayoff and Zhang systems are similar. According to Petitioner, (a) Zhang discloses a confocal system "like" Babayoff and (b) Zhang's projection defocus method is an "alternative" to Babayoff's camera defocus method. *See* Corr. Pet. 27.

Regarding (a), Petitioner states that "Zhang [] discloses a ***confocal*** or ***coaxial*** imaging system *like* Babayoff for obtaining 3D shape information of objects including ***teeth***." Corr. Pet. 27 (citing Ex. 1002 ¶ 66; Ex. 1006, pp. 907–910, Figs. 1, 2, 4, 9) (emphasis added)

However, we agree with Patent Owner in that "Zhang does not recite the term 'confocal'." Prelim. Resp. 34; see Ex. 1006 generally.

Petitioner does not adequately explain in what way Zhang's system is a "confocal or coaxial imaging system" system such that it is "like" that of Babayoff. Petitioner explains that Babayoff discloses a "confocal scanner" (Corr. Pet. 7) that involves using "motor 72 that is linked to the 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 7 (citing Ex. 1005 ¶¶ 101, 11, 32, 142), 26 (citing Ex. 1005 ¶ 142, Figure 4A)). But Petitioner does not sufficiently explain how Zhang's system is "like" that.

Petitioner relies on Dr. Gupta's testimony for support. Corr. Pet. 27 (citing Ex. 1002 ¶ 66). But Dr. Gupta simply repeats, without factual support, what the Petition states: "Zhang [] discloses a confocal or coaxial imaging system like Babayoff. . . ." Ex. 1002 ¶ 66. This does not provide any insight into *how* the Zhang system is "like" that of Babayoff as Petitioner asserts.

Petitioner also relies on various passages and figures in Zhang for support. Corr. Pet. 27 (citing Ex. 1006, pp. 907–910, 914–915, Figures 1, 2, 4, 9). But we are unable to discern from said disclosures how Zhang's system is "like" Babayoff's confocal system. As we explained, Petitioner

describes Babayoff's confocal system as one that involves using "motor 72 that is linked to the telecentric confocal optics 42." Corr. Pet. 26. But we do not see anything similar in Zhang. *Cf.* Ex. 1005, Figure 1, and Ex. 1006, Figure 1. We agree with Patent Owner that "Zhang does not describe or suggest optical or motor elements that are hallmarks of a confocal imaging system." Prelim. Resp. 34.

For these reasons, Petitioner does not establish sufficiently that (a) Zhang teaches a confocal or coaxial imaging system "like" Babayoff.

Regarding (b), Petitioner contends that "Babayoff employs at least partially a ***camera defocus method*** for determining the depth coordinates." Corr. Pet. 27 (citing Ex. 1005 ¶¶ 11, 32, 139–142, Figures 4A, 8). According to Petitioner, Zhang's "***projection defocus method*** in which an ***illumination pattern*** is ***shifted*** across the object being imaged to measure depth" is "an ***alternative*** to [Babayoff's] ***camera defocus method*** for determining the depth coordinates." *Id*. (citing Ex. 1006, pp. 907–910, 914–915, Figures 1, 2).

However, we agree with Patent Owner that "[t]he term 'defocus' is simply not recited in the entirety of the Babayoff document." Prelim. Resp. 32–33.

We observe that Dr. Gupta testifies that "Babayoff employs at least partially a camera defocus method for determining the depth coordinates." Ex. 1002 ¶ 66 (citing Ex. 1005, ¶¶ 11, 32, 139–142, Figures 4A, 8). But Dr. Gupta simply repeats, without factual support, what the Petition states. *Cf.* Corr. Pet. 27. This does not provide any insight into *how* the Babayoff employs a camera defocus method as Petitioner asserts.

We have reviewed the Babayoff passages cited by Petitioner and Dr. Gupta (*i.e.*, Ex. 1005 ¶¶ 11, 32, 139–142, Figures 4A, 8) and, as Patent Owner points out, they do not contain any discussion about a "camera defocus method." Prelim. Resp. 33. Petitioner provides no explanation as to how it is that Babayoff employs a "camera defocus method" notwithstanding there is no mention of it in the passages of Babayoff that it cites. Because no explanation is given, the cited passages insufficiently support Petitioner's assertion that Babayoff teaches a "camera defocus method."

Given the insufficiency of the factual support for the contention that Babayoff teaches a "camera defocus method," Petitioner does not establish sufficiently that (b) Zhang's projection defocus method is an "alternative" to Babayoff's "camera defocus method."

Therefore, Petitioner does not sufficiently support its contention that Zhang's projection defocus method is similar to Babayoff's confocal imaging system.

Petitioner does not otherwise address the differences between Zhang's projection defocus method, exemplified by the use of a DLP or LCD projector, and Babayoff's confocal system involving using "motor 72 that is linked to the telecentric confocal optics 42" (Corr. Pet. 26). Petitioner does not explain why a POSA would have been led to modify Babayoff in light of Zhang given these differences.

For the foregoing reasons, Petitioner provides insufficient reasoning with rational underpinnings in support of its contention that a POSA would have been motivated to ("straightforward") replace the illumination source 31 in Babayoff with the DLP or LCD projector of Zhang with a reasonable

expectation of successfully arriving at the claimed invention comprising 1[c]. Pet. 30.

For the above reasons, we are unpersuaded that the Petition establishes a reasonable likelihood that claim 1 is unpatentable over Babayoff, Zhang, and Knighton.

2. Claims 14 and 26

Independent claims 14 and 26 recite the same limitation as 1[c] discussed above. *See* Ex. 1001, 38: 53–55 (claim 14), 40:7–9 (claim 26).

Petitioner's position that "Babayoff in combination with Zhang satisfies these limitations [1[c]] of claim 1" (Corr. Pet. 24 (citing Ex. 1002 ¶¶ 61–72)) also applies to claims 14 and 26. *See id.* at 60 (citing Ex. 1002 ¶ 122), 65 (citing Ex. 1002 ¶ 139).

For the same reasons, therefore, as set forth above for the corresponding limitation of independent claim 1, the Petition does not establish a reasonable likelihood that claims 14 and 26 are unpatentable over Babayoff, Zhang, and Knighton.

3. Dependent Claims 2–8, 13, 15, 16, 18–22, 28, and 29

Claims 2–8 and 13; 15, 16 and 18–22; and, 28 and 29 depend from claims 1, 14, and 26, respectively.

For the same reasons as set forth above, namely, that Petitioner provides insufficient reasoning with rational underpinnings in support of its contention that a POSA would have been motivated to ("straightforward") replace the illumination source 31 in Babayoff with the DLP or LCD projector of Zhang with a reasonable expectation of successfully arriving at the claimed invention comprising 1[c], the Petition does not establish a

reasonable likelihood that claims 2–8, 13, 15, 16, 18–22, 28, and 29 are unpatentable over Babayoff, Zhang, and Knighton.

F. Ground II—Obviousness over Babayoff, Zhang, Knighton, and Serra

Petitioner challenges claims 12, 17, and 27 as unpatentable under 35 U.S.C. § 103(a) over Babayoff, Zhang, Knighton, and Serra. Corr. Pet. 68–70.

Petitioner relies on its position under Ground I in challenging the patentability of claims 1, 14, and 26, from which claims 12, 17, and 27 depend, respectively. Pet. 68 ("The limitations of claim 1 are disclosed by the combination of Babayoff, Zhang, and Knighton as discussed under Ground 1.").

For the same reasons as set forth in section II.E.1., namely, that Petitioner provides insufficient reasoning with rational underpinnings in support of its contention that a POSA would have been motivated to ("straightforward") replace the illumination source 31 in Babayoff with the DLP or LCD projector of Zhang with a reasonable expectation of successfully arriving at the claimed invention comprising 1[c], the Petition does not establish a reasonable likelihood that claims 12, 17, and 27 are unpatentable over Babayoff, Zhang, Knighton, and Serra.

III. CONCLUSION

For the foregoing reasons, we determine that Petitioner has not demonstrated a reasonable likelihood that it would prevail with respect to at least one of the claims challenged in the Petition. We do not institute an *inter partes* review on any of claims 1–8, 12–22, and 26–29 of the '667 patent on any ground.

IV. ORDER

It is

ORDERED that the Petition is denied, and that we do not institute an *inter partes* review of any claim of claims 1–8, 12–22, and 26–29 of the '667 patent.

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