

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

3SHAPE A/S and 3SHAPE INC.,
Petitioner,

v.

DENTAL IMAGING TECHNOLOGIES CORPORATION,
Patent Owner.

IPR2024-00549
Patent 11,234,798 B2

Before HUBERT C. LORIN, STACEY G. WHITE, and
FRANCES L. IPPOLITO, *Administrative Patent Judges*.

IPPOLITO, *Administrative Patent Judge*.

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

I. INTRODUCTION

3Shape A/S and 3Shape Inc. (“Petitioner”) filed a Petition (Paper 3, “Pet.”) requesting *inter partes* review of claims 1–20 of U.S. Patent No. 11,234,798 B2 (Ex. 1001, “the ’798 patent”). Dental Imaging Technologies Corporation (“Patent Owner”) filed a Preliminary Response (Paper 7, “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 not a reasonable likelihood that Petitioner would prevail in challenging at least one of claims 1–20 of the ’798 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 ’798 patent.

A. *Real Parties in Interest*

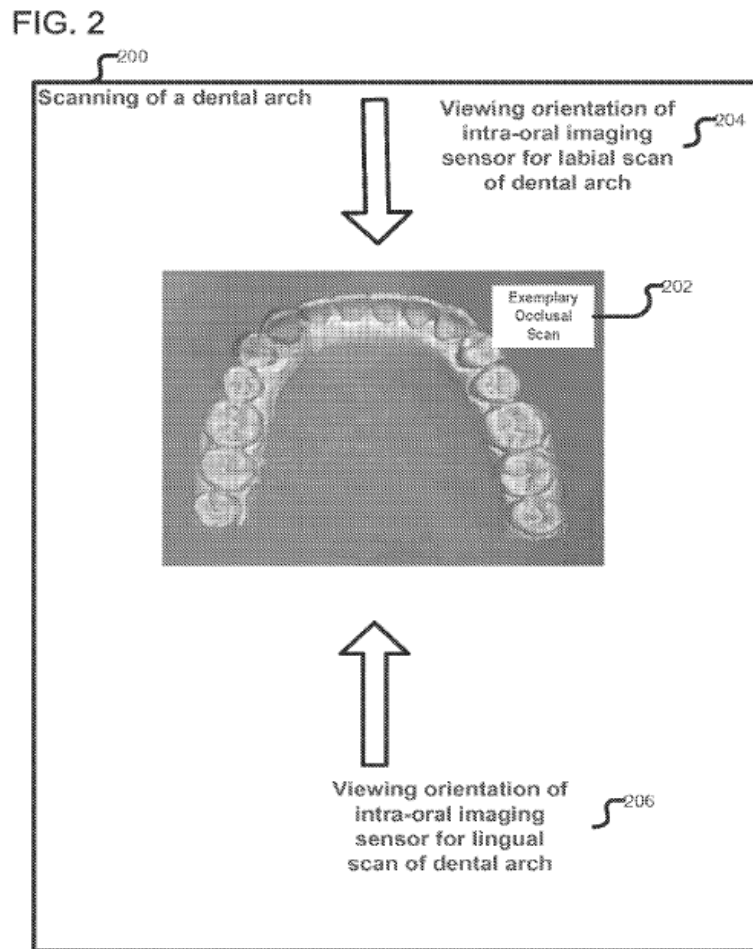
Petitioner identifies 3Shape A/S, 3Shape Inc., 3Shape Holding A/S, 3Shape Trios A/S, and 3Shape Poland sp. z.o.o. as the real parties-in-interest. Pet. 1. Patent Owner identifies Dental Imaging Technologies Corporation as the real party-in-interest. Paper 5, 2.

B. *Related Matters*

The parties indicate that the ’798 patent has been asserted in the following district court litigation: *3Shape A/S v. Carestream Dental, LLC et al.*, Civ. Action No. 1:22-cv-01829 (N.D. Ga.), which was transferred from *3Shape A/S v. Carestream Dental LLC*, Civ. Action No. 6:21-cv-01110 (W.D. Tex.). Pet. 2; Paper 5, 2.

C. The '798 patent

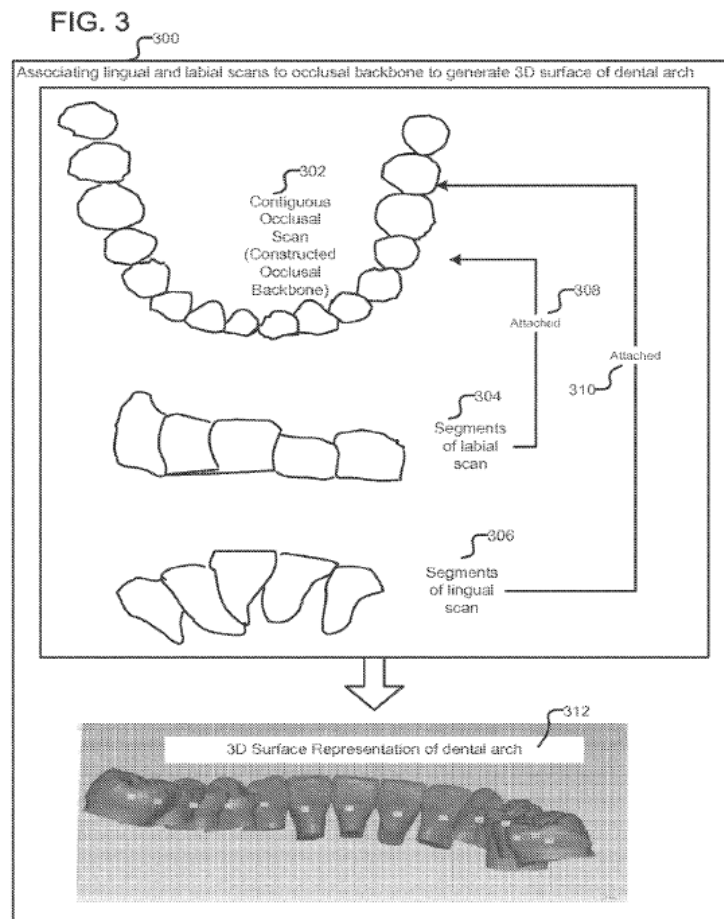
The '798 patent relates generally to “a system, method, and computer readable storage medium for generating an intra-oral scan of a dentition.” Ex. 1001, code (54). Figure 2, reproduced below, illustrates the scanning of a dental arch. Ex. 1001, 2:55–56.



In Figure 2, shown above, diagram 200 illustrates the scanning of a dental arch. *Id.* at 5:42–43. Occlusal scan 202 is generated by gliding wand 108 (not shown) over the occlusal surface of a dental arch of the patient. *Id.* at 5:43–46. Diagram 200 illustrates the viewing orientation of wand 108 comprising intra-oral imaging sensor 112 (not shown) for labial scan 204

and lingual scan 206. *Id.* at 5:46–50. “In the lingual scan, the side surfaces of the teeth that are predominantly faced towards the tongue are imaged.” *Id.* at 5:50–52. “In the labial scan[,] the side surfaces of the teeth that are predominantly faced towards the lips and cheek are imaged.” *Id.* at 5:52–54.

Figure 3, reproduced below, is “a diagram that shows how lingual and labial scans are associated with an occlusal backbone to generate a three-dimensional surface representation of a dental arch.” *Id.* at 2:57–60.

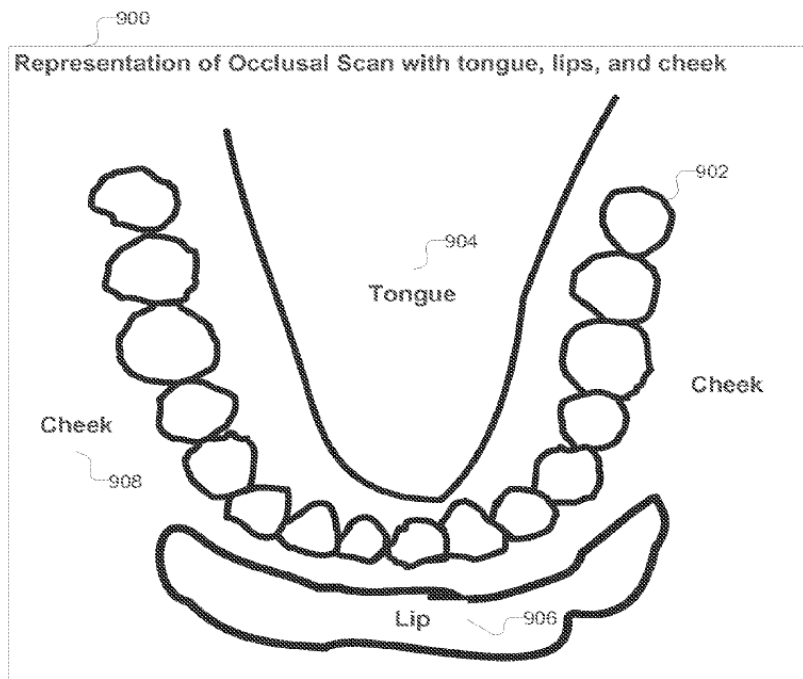


In Figure 3, shown above, diagram 300 illustrates a representation of occlusal backbone 302 that is constructed from a contiguous occlusal scan, a segment of labial scan 304, and a segment of lingual scan 306. *Id.* at 5:59–63. Multiple segments of labial scan 304 and lingual scan 306 may be

needed to cover the entire dental arch. *Id.* at 5:64–66. The segments of labial scan 304 and the segments of lingual scan 306 are attached 308, 310 to occlusal backbone 302 to generate a three-dimensional surface representation of dental arch 312. *Id.* at 5:66–6:3.

Figure 9, reproduced below, illustrates a diagram that shows a representation of an occlusal scan with a tongue, lips, and a cheek. *Id.* at 3:10–11.

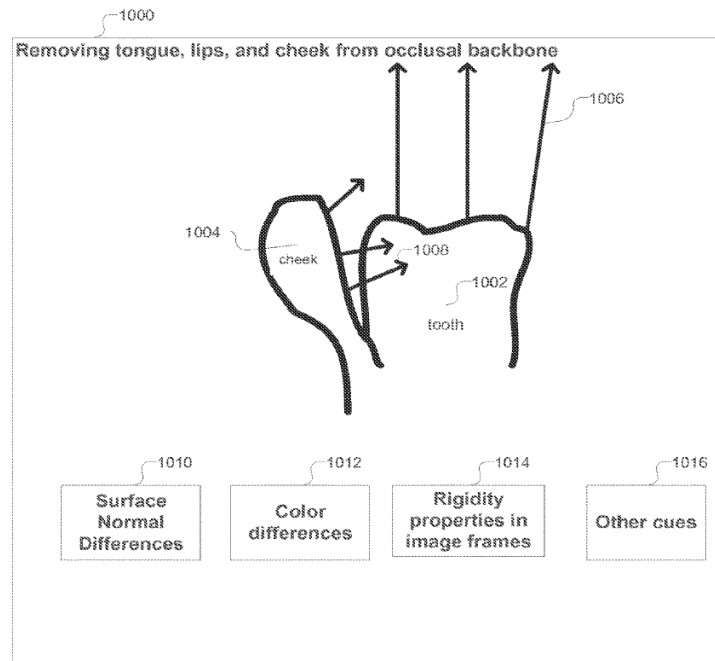
FIG. 9



In Figure 9, shown above, diagram 900 shows a representation of an occlusal scan 902 with tongue 904, lips 906, and cheek 908. *Id.* at 9:14–16.

Figure 10, reproduced below, illustrates a diagram that shows how a tongue, lips, and a cheek are removed from the occlusal backbone. *Id.* at 3:14–15.

FIG. 10



In Figure 10, shown above, diagram 100 illustrates an exemplary tooth 1002 and cheek 1004. *Id.* at 9:26–27. “[T]he surface normals 1006 of tooth 1002 are oriented differently than the surface normal 1008 of cheek 1004.” *Id.* at 9:28–30. There may be color differences between tooth 1008 and cheek 1004. *Id.* at 9:30–32. Because cheek 1004 is non-rigid and tooth 1008 is rigid, image characteristics in a sequence of frames may be used to determine non-rigid objects like a cheek or lips or a tongue. *Id.* at 9:32–34. “[B]y determining one or more of surface normal differences 1010, color differences 1012, rigidity property differences 1014, and other cues 1016 the

areas of the occlusal scan that represent a cheek, [a] tongue, and lips are removed from the occlusal backbone.” *Id.* at 9:35–39.

D. Challenged Claims

Petitioner challenges claims 1–20. Pet. 1. Claims 1 and 10 are independent claims. Claim 1 is reproduced below with, in brackets, the Petitioner’s identifiers:

1. [Preamble] A system, for generating an intra-oral scan of a dentition, the system comprising:

[1.1] a memory; and

[1.2] a processor coupled to the memory, wherein the processor is configured to:

[1.3] generate a contiguous scan of an occlusal surface of at least a part of one arch of the dentition,

[1.4] remove image data of soft tissue from the contiguous scan of the occlusal surface based at least in part on an analysis of 3D data from the contiguous scan to distinguish between image data of the dentition and the image data of the soft tissue, wherein the soft tissue includes at least one selected from a group consisting of a tongue, a cheek, and a lip, and

[1.5] associate a scan of at least one additional surface to the contiguous scan of the occlusal surface by

[1.6] analyzing the scan data to identify a portion of the scan of the at least one additional surface that overlaps with a portion of the contiguous scan of the occlusal surface,

[1.7] wherein the scan of the at least one additional surface includes a sequence of image frames including a plurality of image frames of the occlusal surface interspersed with a plurality of image frames of the at least one additional surface, and

- [1.8] determining a position of the scan of the at least one additional surface relative to the scan of the occlusal surface based on the identified overlapping portions,
- [1.9] wherein the processor is configured to generate the contiguous scan of the occlusal surface by capturing a plurality of partially overlapping image frames of the occlusal surface and stitching the overlapping image frames together to form a 3D model of the occlusal surface,
- [1.10] wherein the processor is configured to remove the image data of the soft tissue from the contiguous scan by removing the image data of the soft tissue from the overlapping image frames used to generate the occlusal scan, and
- [1.11] wherein the processor is further configured to update the contiguous scan of the occlusal surface by restitching the overlapping image frames together after removing the image data of the soft tissue to form an updated 3D model of the occlusal surface.

Ex. 1001, 15:5–48.

Claim 10 is reproduced below with, in brackets, the Petitioner's identifiers:

10. (Preamble) A computer readable storage medium for generating an intra-oral scan of a dentition, wherein code stored in the computer readable storage medium, when executed by a processor, causes a system to:

- [10.1] generate a contiguous scan of an occlusal surface of at least a part of one arch of the dentition by capturing a plurality of partially overlapping image frames of the occlusal surface and stitching the overlapping image frames together to form a 3D model of the occlusal surface;
- [10.2] remove image data of soft tissue from the overlapping image frames used to generate the occlusal scan based at least in part on an analysis of 3D data from the contiguous scan to distinguish between image data of the dentition and

the image data of the soft tissue, wherein the soft tissue includes at least one selected from a group consisting of a tongue, a cheek, and a lip;

[10.3] update the contiguous scan of the occlusal surface by restitching the overlapping image frames together after removing the image data of the soft tissue to form an updated 3D model of the occlusal surface; and

[10.4] associate a scan of at least one additional surface to the contiguous scan of the occlusal surface by analyzing the scan data to identify a portion of the scan of the at least one additional surface that overlaps with a portion of the contiguous scan of the occlusal surface,

[10.5] wherein the scan data includes a sequence of image frames including a plurality of image frames of the occlusal surface interspersed with a plurality of image frames of the at least one additional surface and

[10.6] determining a position of the scan of the at least one additional surface relative to the scan of the occlusal surface based on the identified overlapping portions.

Ex. 1001, 16:41–17:9.

E. Prior Art and Asserted Grounds

Petitioner asserts that claims 1–20 would have been unpatentable on the following grounds:

Claim(s) Challenged	35 U.S.C. §	Reference(s)/Basis
1–6, 10–15, 17–19	103	Zhang, ¹ Babayoff ²
7, 16	103	Zhang, Babayoff, Fisker ³

¹ WIPO Application Publication No. WO 2010/077380 A2, published July 8, 2010 (Ex. 1007) (“Zhang”).

² U.S. Patent No. 7,698,068 B2, issued Apr. 13, 2010 (Ex. 1008) (“Babayoff”).

³ WIPO Application Publication No. WO 2013/010910 A1, published Jan. 24, 2013 (Ex. 1009) (“Fisker”).

Claim(s) Challenged	35 U.S.C. §	Reference(s)/Basis
8	103	Zhang, Babayoff, Dillon ⁴
9, 20	103	Zhang, Babayoff, Johnson ⁵

Pet. 5. Petitioner relies on the Declarations of Eli Saber Ph.D. (Ex. 1003) and Sylvia D. Hall-Ellis (Ex. 1005).

II. ANALYSIS

A. *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 a person of ordinary skill in the art (“POSITA”) at the time of the invention of the ’798 patent would have at least (1) a bachelor’s degree in electrical engineering, computer engineering, or computer science (or equivalent course work) and *two to three years of work experience in 3D imaging and modeling of physical structures*, or (2) a master’s degree in electrical engineering, computer engineering, or computer science (or equivalent course work) with a focus in 3D imaging and modeling of physical structures.

⁴ U.S. Patent Application Publication No. 2012/0062701 A1, published Mar. 15, 2012 (Ex. 1010) (“Dillon”).

⁵ A. Johnson, “Spin-images: A Representation for 3-D Surface Matching,” Ph.D. Dissertation, The Robotics Institute, Carnegie Mellon University, August 1997 (Ex. 1011) (“Johnson”).

Pet. 7–8 (emphasis added). Patent Owner counters that a POSITA at the time of the invention of the '798 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 two years of work experience, or alternatively, at least five years of comparable industry experience in the field of imaging and/or image scanning including 3D imaging systems and 3D modeling techniques. Additional education reduces the threshold for years of experience in the field, and vice versa.

Prelim. Resp. 5

For purposes of this Decision, the level of ordinary skill in the art is not dispositive and our determination would be the same under either party's proposal. *See* Prelim. Resp. 5 (“Patent Owner’s substantive arguments in this Preliminary Response apply regardless which proposed level of skill is applied.”). Nonetheless, we note that Petitioner’s proposal is reasonable and consistent with the prior art, and is further supported by Dr. Saber’s testimony. Ex. 1003 ¶ 34; *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).

B. Principles of Law

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. Claim Construction

In an *inter partes* review for a petition such as this one, filed on or after November 13, 2018, a claim “shall be construed using the same claim construction standard that would be used to construe the claim in a civil action under 35 U.S.C. 282(b).” 37 C.F.R. § 42.100(b). We apply the claim construction standard from *Phillips v. AWH Corp.*, 415 F.3d 1303, 1312–13 (Fed. Cir. 2005) (*en banc*). 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.

Petitioner notes there are proposed constructions of terms in the related litigation, including constructions for “contiguous scan” and “occlusal surface.” Pet. 8–9. Here, Petitioner further contends that the term “occlusal surface” means “the biting surface of a patient’s teeth” and that “contiguous scan” means “a scan of an/the occlusal surface made in a single, uninterrupted motion of the scanning wand.” *Id.* at 8.

Nonetheless, Petitioner contends also that “resolution of this Petition does not depend on which constructions are used because these features of the claims are disclosed by the prior art regardless of the construction.” *Id.* at 9.

Patent Owner disagrees that no claim terms need construction. Prelim. Resp. 6. According to Patent Owner, “3Shape has not adequately addressed how numerous elements of the challenged claims are disclosed or suggested by the prior art under 3Shape’s proposed construction of the phrase ‘contiguous scan of an occlusal surface.’” *Id.*

Based on our review of the parties’ arguments and evidence, no construction is necessary to resolve the parties’ disputes. *Vivid Techs., Inc. v. Am. Sci. & Eng’g, Inc.*, 200 F.3d 795, 803 (Fed. Cir. 1999) (“[O]nly those terms need be construed that are in controversy, and only to the extent necessary to resolve the controversy.”).

D. Ground 1: Claims 1–6, 10–15, and 17–19 as Obvious over Zhang in View of Babayoff

1. Zhang (Ex. 1007)

Zhang is a WIPO International Publication titled “Global Camera Path Optimization.” Ex. 1007, code (54). Zhang relates generally to 3-D imaging and more specifically to optimizing the calculation of a global camera path used in a 3-D reconstruction. *Id.* ¶2. Zhang’s Figure 1, reproduced below, depicts a 3-D scanning system 100:

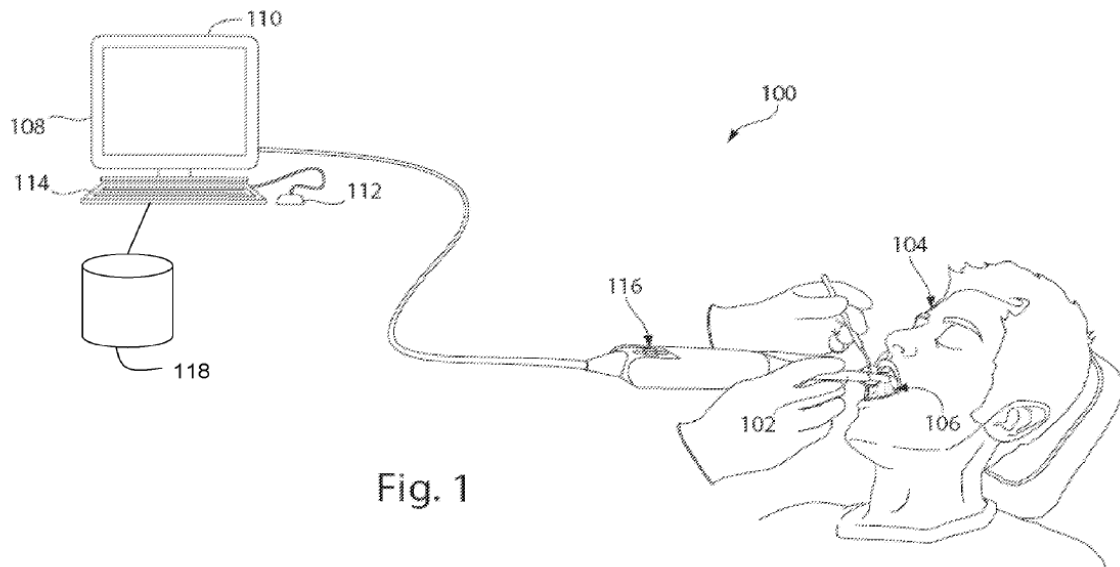


Figure 1, shown above, depicts 3-D scanning system 100, including scanner 102 that captures images from surface 106 of dental patient 104 and forwards the images to computer 108, which may include display 110 and one or more user-input devices, such as mouse 112 or keyboard 114. *Id.*

¶ 41. Zhang discloses that scanner 102 may also include an integrated input or output device 116 such as a control input (e.g., button, touchpad, thumbwheel, etc.) or a display (e.g., LCD or LED display) to provide status information. *Id.*

Zhang discloses that computer 108 includes a processor and computer-usable medium 118 comprising memory chips, a hard drive, and the like. *Id.* ¶ 50. Zhang adds that computer-usable medium 118 can store “computer-readable instructions for execution by the computer 108 to perform the processes described.” *Id.*

Zhang’s Figure 4A, reproduced below, illustrates camera paths for a three-dimensional scanner:

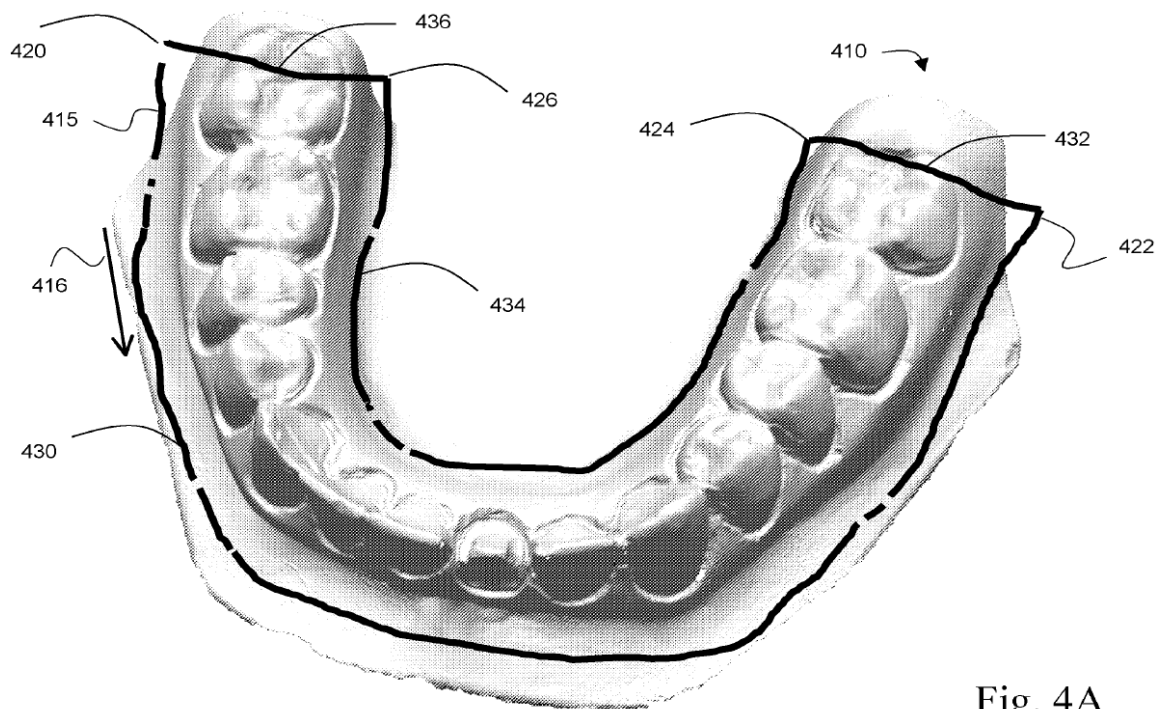


Fig. 4A

Figure 4A, shown above, depicts object 410 for imaging, along with path 415 that a camera may follow while obtaining a three-dimensional scan of a surface of object 410. *Id.* ¶ 58. Zhang describes that the direction of path 415 is indicated generally by arrow 416. *Id.* “Starting the camera at starting point 420, the camera may follow arc 430 to second point 422.” *Id.* Zhang further describes that the camera may then follow segment 432 to third point 424, second arc 434 to fourth point 426, and second segment 436 to return approximately to starting point 420. *Id.*

2. *Babayoff* (Ex. 1008)

Babayoff is a U.S. Patent titled “Method for Providing Data Associated with the Intraoral Cavity.” Ex. 1008, code (54). *Babayoff* relates generally to color 3-D numerical entities representative of the intraoral cavity and the manipulation of such entities to provide data that is useful in procedures associated with the oral cavity’s dental surfaces. *Id.* at 1:19–21. Figure 14 of *Babayoff*, reproduced below, illustrates the main

steps in a method for automatically differentiating one tissue from another tissue within the oral cavity. *Id.* at 7:36; 20:65–21:1.

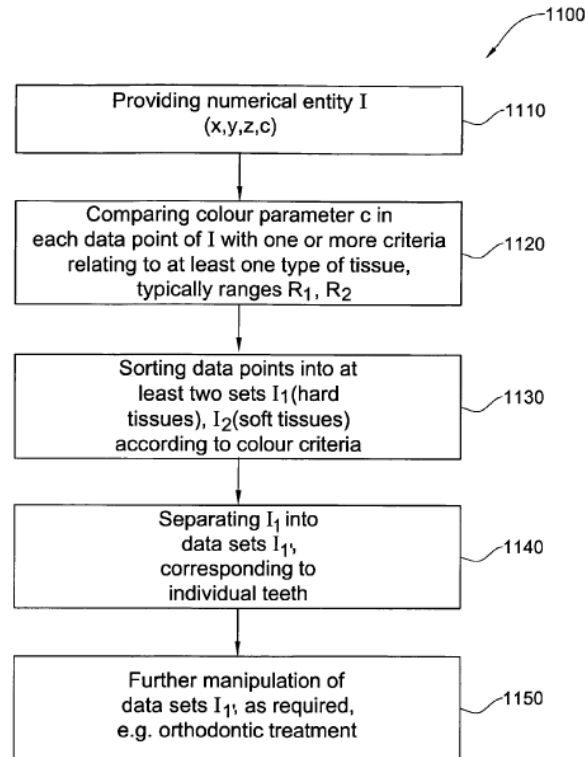


FIG. 14

Figure 14 shows method 1100 with steps 1110, 1120, 1130, 1140, and 1150 for automatically differentiating tissues within the oral cavity by comparing color criteria. Babayoff further discloses scanning parts of the intra-oral cavity sequentially and subsequently stitching the various data sets together. *Id.* at 2:3–5. For some embodiments, Babayoff discloses eliminating data associated with soft tissues, and then proceeding with stitching color data associated with hard tissues to improve the quality of the stitching procedure in comparison to using the full intra-oral data. *Id.* at 5:11–16.

3. *Claim 1*

Petitioner contends that Zhang in view of Babayoff renders obvious claim 1. Pet. 10–29.

Independent claim 1 of the '798 patent is generally directed to a system for generating intra-oral scans of dentition. Ex. 1001, 15:5–6. More specifically, claim 1 recites a processor that is configured to:

- “[1.3] generate a contiguous scan of an occlusal surface of at least a part of one arch of the dentition”
- “[1.9] generate the contiguous scan of the occlusal surface by capturing a plurality of partially overlapping image frames of the occlusal surface and stitching the overlapping image frames together to form a 3D model of the occlusal surface”
- “[1.10] remove the image data of the soft tissue *from the contiguous scan* by removing the image data of the soft tissue from the overlapping image frames used to generate the occlusal scan,” and
- “[1.11] update the *contiguous scan of the occlusal surface by restitching* the overlapping image frames together after removing the image data of the soft tissue to form an updated 3D model of the occlusal surface.”

Ex. 1001, 15:10–11, 15:33–48 (emphases added).

a) Petitioner's Contentions

For these limitations, Petitioner asserts Zhang's scanner 102 and computer 108 (which includes the processor) are coupled together and that the system captures the images obtained from the scanner as it moves along a surface. Pet. 23–24 (citing Ex. 1007 ¶¶ 43, 47; Ex. 1003 ¶¶ 108–109).

Petitioner adds that Zhang’s scanner 102 may use a continuous data acquisition process. *Id.* at 24 (citing Ex. 1007 ¶ 43). Petitioner further quotes Zhang’s teaching that

[t]he three-dimensional point clouds from individual image sets may be combined by a three-dimensional stitching module 336. Finally, the stitched measurements may be combined into an integrated three-dimensional model by a three-dimensional model creation module 338. . . . [K]ey frames should be related to one another in a manner that permits characterization of a camera path, typically through the registration of overlapping three-dimensional data in respective key frames.

Id. at 25 (quoting Ex. 1007 ¶¶ 55–56); Ex. 1003 ¶ 113.

Petitioner further asserts that Babayoff discloses scans of soft tissue and dentition to obtain 3D data and the separation or removal of the soft tissue data from the hard tissue. *Id.* at 14–16 (citing Ex. 1008, 2:1–18, 5:11–16, 8:30–66, 9:63–10:28, 21:6–7, 22:11–61, 23:34–36, 24:25–47, 26:4–7; Ex. 1003 ¶¶ 78–82); *see also id.* at 26–27 (citing Ex. 1008, 5:11–16, 22:11–61, 23:34–36, 24:25–47, 26:4–7; 47; Ex. 1003 ¶ 117). According to Petitioner, columns 23–26 of Babayoff teach a system for accurately stitching data sets of overlapping area scanned within the intra-oral cavity and then “restitching the remaining image data of the hard tissue (the teeth) to create a more accurate model of the intra-oral cavity.” Pet. 27–28 (citing Ex. 1008, 23:50–51; Ex. 1003 ¶ 122).

Relying on the testimony of its declarant, Dr. Saber, Petitioner further contends that “[a] POSITA would have had motivation to combine the system of Zhang with the processing of Babayoff to achieve a more accurate 3D representation of the teeth that did not include images of soft tissue in the patient’s mouth.” Pet. 47 (citing Ex. 1003 ¶ 234). Petitioner’s declarant,

Dr. Saber, testifies that “[s]uch soft tissue can be problematic if it blocks or prevents proper reconstruction of the hard surface of the teeth, such as might occur if a portion of the patient’s tongue or cheek appeared in the scan.” Ex. 1003 ¶ 235.

Petitioner further contends that Babayoff discloses that 3D reconstructions with soft tissue will lead to improperly fitting orthodontics and dental prostheses, and that one way to improve the 3D reconstruction is to identify and remove the soft tissue in the reconstruction. Pet. 48 (citing Ex. 1008, 24:25–47; Ex. 1003 ¶¶ 236–38). Petitioner argues that

[a] POSITA would readily recognize that the system of Zhang could be improved to create more accurate orthodontics if soft tissue was removed from the 3D reconstructions. This is consistent with the principle behind Zhang, which was to create more accurate 3D reconstructions of teeth. The process described in Babayoff would be one such obvious choice available at that time.

Id. (citing Ex. 1003 ¶ 239).

Petitioner adds that there is a reasonable expectation of success that modifying Zhang’s system with the technique described in Babayoff would yield a successful result. Pet. 49 (citing Ex. 1003 ¶ 242). Petitioner contends that “[m]odifying Zhang to achieve the claimed invention of the ’798 Patent would only require modification of the existing software to differentiate the soft tissue from the dentition and then remove it, which is readily possible once the teachings of Babayoff are used.” *Id.* (citing Ex. 1003 ¶ 241).

b) Patent Owner’s Contentions

Patent Owner presents several arguments, including that claim limitation 1.10 requires the removal of soft tissue image data from the

already stitched together overlapping images. Prelim. Resp. 22. According to Patent Owner, “[t]hat soft tissue is removed after the frames have been stitched is equally plain from limitation [1.11], which requires that ‘the processor is further configured to update the contiguous scan of the occlusal surface by restitching the overlapping image frames together after removing the image data of the soft tissue’” *Id.* (citing Ex. 1001, claim 1 (emphasis added)). Patent Owner contends that Babayoff does not teach or suggest removal of soft tissue from the image frames that were already stitched to form the contiguous scan of an occlusal surface. *Id.* at 23 (citing Ex. 1008, 5:11–16 (“By eliminating the data associated with the soft tissues, and proceeding with stitching only the hard tissues using the color data, the quality of the stitching procedure is significantly better than when using the full intra-oral data for the stitching procedure.”))

c) Discussion

To Patent Owner’s point, claim 1 expressly requires that the generated contiguous scan of an occlusal surface includes overlapping frames stitched together to form a 3D model. *Id.* More specifically, claim 1 recites that the processor is configured to “generate a contiguous scan of an occlusal surface of at least a part of one arch of the dentition [1.3] . . . by capturing a plurality of partially overlapping image frames of the occlusal surface and *stitching the overlapping image frames together to form a 3D model* of the occlusal surface [1.9].” Ex. 1001, 15:10–11, 15:33–38 (emphases added). Once this contiguous scan has been generated, the processor is configured to “*remove the image data of the soft tissue from the contiguous scan* by removing the image data of the soft tissue from the overlapping image frames used to generate the occlusal scan [1.10].” *Id.* at 15:39–43 (emphases added). The

processor is also configured to then “update the contiguous scan . . . by *restitching* the overlapping image frames together after removing the image data of the soft tissue to form an updated 3D model of the occlusal surface.” *Id.* at 15:44–48 (emphasis added).

In contrast, Babayoff describes a method for first identifying and/or discarding the surface data of soft tissues like cheeks and tongue that may distort and move while scans are performed. Ex. 1008, 2:16–19. Babayoff’s Figure 14 is reproduced below:

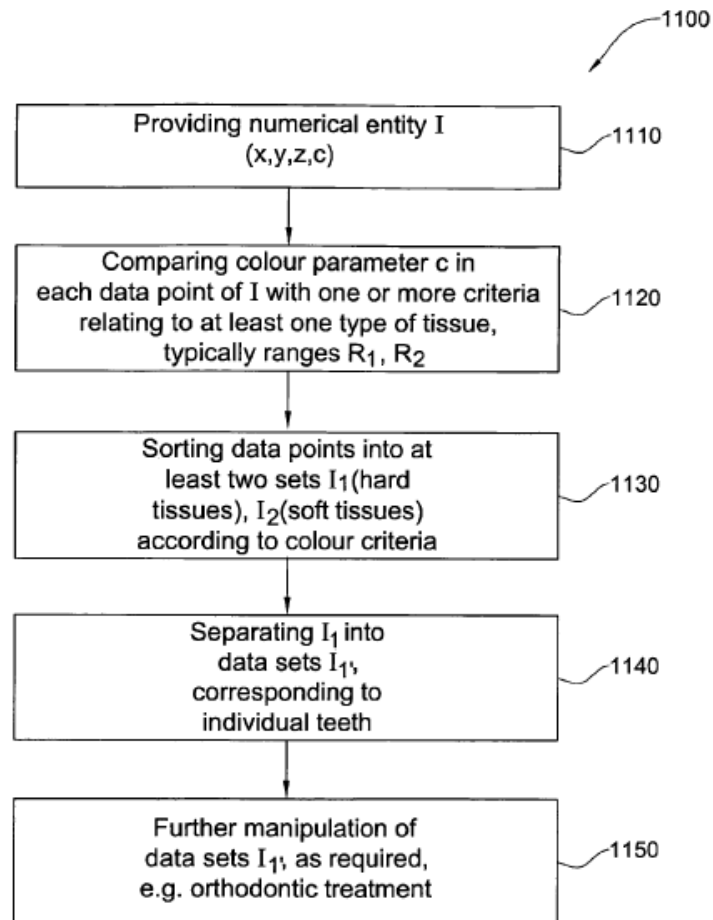


FIG. 14

Figure 14 is a chart that illustrates the main steps of method 1110 that “is particularly adapted for automatically differentiating one tissue from another tissue within the oral cavity.” Ex. 1008, 20:65–21:1. In step 1110, a numerical entity I is obtained that comprises a data set of surface geometry and color for the intraoral cavity. *Id.* at 21:1–5. In step 1120, the value of the color parameter c is analyzed for each data point in I, and compared with color criterion to sort the data points into sub-data sets, e.g., hard I₁ and soft I₂ tissues. *Id.* at 21:23–32, 22:21–23. In step 1140, the sub-data sets may be further separated out into smaller entities, such as that corresponding to individual teeth. *Id.* at 22:47–54. “[A]fter the data relating to the individual teeth has been properly sorted, further manipulation may be carried out for each of the individual data sets” in step 1150. *Id.* at 22:57–61. We observe that Babayoff does not describe stitching of the data sets with regarding to the method described in Figure 14.

For stitching, Petitioner directs us to the process described in Figure 15 of Babayoff. Figure 15 is provided below:

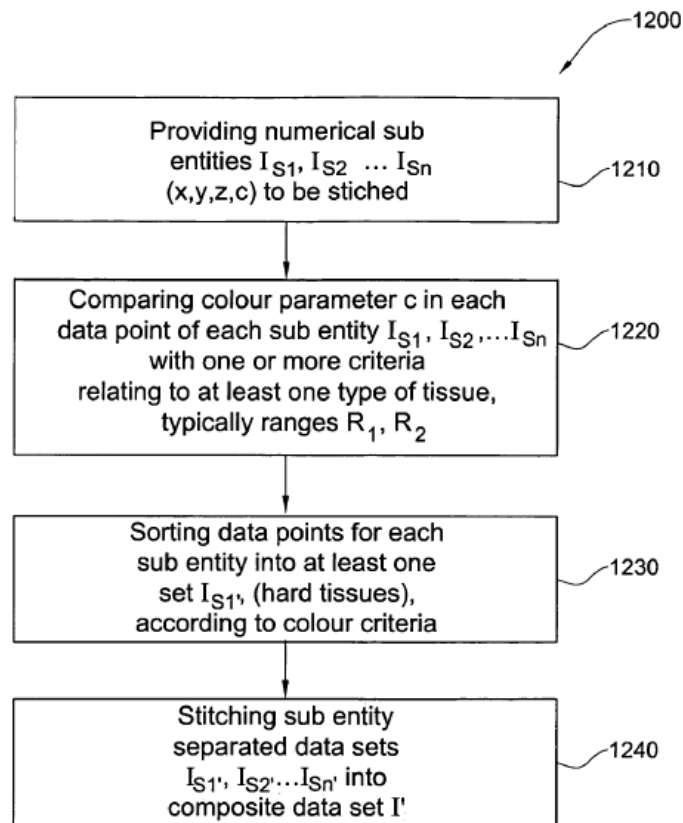


FIG. 15

Figure 15 is chart showing the main steps of a “second embodiment” method 1200 described in Babayoff. Ex. 1008, 7:3–39. Babayoff teaches that in first step 1210, high resolution numerical sub-entities (I_{S1} , I_{S2} , . . . I_{Sn}) are obtained using a scanner. *See id.* at 23:51–56. These sub-entities represent the surface topography and color of zones (A_1 , A_2 , . . . A_n) within the intra-oral cavity. *Id.* Babayoff further teaches that by identifying the overlap zone withing these sub-entities, some of these may be stitched together “to form a global numerical entity that comprises the full geometry and color representation of the target zone.” *Id.* at 23:65–24:3.

For the actual stitching, Babayoff teaches that in step 1220, the hard tissues are differentiated from the soft tissues by substantially the same method as described in Figure 14. Ex. 1008, 24:25–34. “The data in these entities not corresponding to the hard tissues may be discarded or simply noted and set aside . . . thereby providing modified entities ($IS'_1, IS'_2, \dots IS'_n$) comprising the data of interest relating to the hard tissues.” Then, “[i]n the next step 1230 . . . the modified entities ($IS'_1, IS'_2, \dots IS'_n$) are then manipulated in a similar manner . . . to register and then stitch the various modified entities ($IS'_1, IS'_2, \dots IS'_n$) together to provide a composite entity I' that comprises the data points corresponding at least to the hard tissues.”

As described, we understand Babayoff to teach that data entities $IS'_1, IS'_2, \dots IS'_n$ are stitched together *after* identifying and removing soft tissue data from the unstitched data sub-entities. Our understanding of Babayoff is consistent with Figure 15, where Babayoff teaches that the entities $IS_1, IS_2, \dots IS_n$ are provided in step 1210 “to be stitched,” but are not stitched until step 1240. Ex. 1008, Fig. 15. Babayoff further discloses that the images are stitched together *after soft tissue identification and/or removal*:

[i]n the next step 1230 of the method, the modified entities ($IS'_1, IS'_2, \dots IS'_n$) are then manipulated in a similar manner in which the original entities ($I_1, I_2, \dots I_n$) are manipulated in the prior art, *mutatis mutandis*, to register and *then stitch the various modified entities ($IS'_1, IS'_2, \dots IS'_n$) together* to provide a composite entity I' that comprises the data points corresponding at least to the hard tissues.

Id. at 24:41–47 (emphases added). As such, in Babayoff, the soft tissue is removed prior to stitching and generating the composite entity I' . Babayoff further teaches that “[b]y eliminating the data associated with the soft tissues, and *proceeding with stitching only the hard tissues* using the color

data, the quality of the stitching procedure is significantly better than when using the full intra-oral data for the stitching procedure.” Id. at 5:12–16 (emphases added).

Given at least this disclosure, we agree with Patent Owner that Petitioner has not sufficiently explained how Zhang combined with Babayoff discloses claim limitations [1.3], [1.9], [1.10], and [1.11]. More specifically, Petitioner relies upon Babayoff to disclose the removal of soft tissue data from the generated contiguous scan, but does not explain how Babayoff teaches this removal from the contiguous scan that has been generated by stitching images together prior to soft tissue data removal.

Petitioner further directs us to columns 25 and 26 of Babayoff. There, Babayoff describes methods shown in Figures 16 and 17 that do not discuss stitching of data. Ex. 1008, 25:1–26:67. Rather, the method shown in Figure 16 is “used for automatically defining the finish line of a preparation” and the method in Figure 17 is “applied to the shading of a prosthesis.” *Id.* at 25:4–7, 26:8–10.

Dr. Saber’s testimony in paragraphs 123, 124, and 125 mirror the statements and citations made in the Petition. However, Dr. Saber’s testimony does not persuade us to ignore Babayoff’s express disclosure with reference to Figure 15 that the hard tissue data set is stitched together after soft tissue data has been removed. *See* Ex. 1008, Fig. 15.

Accordingly, Petitioner has not shown a reasonable likelihood of prevailing on this challenge against claim 1.

4. *Claim 10*

Independent claim 10 is directed to a computer readable storage medium for generating an intra-oral scan of a dentition, wherein code stored

in the computer readable storage medium, when executed by a processor, causes a system to:

- [10.1] generate a contiguous scan of an occlusal surface of at least a part of one arch of the dentition by capturing a plurality of partially overlapping image frames of the occlusal surface and stitching the overlapping image frames together to form a 3D model of the occlusal surface;
- [10.2] remove image data of soft tissue from the overlapping image frames used to generate the occlusal scan based at least in part on an analysis of 3D data from the contiguous scan to distinguish between image data of the dentition and the image data of the soft tissue, wherein the soft tissue includes at least one selected from a group consisting of a tongue, a cheek, and a lip;
- [10.3] update the contiguous scan of the occlusal surface by restitching the overlapping image frames together after removing the image data of the soft tissue to form an updated 3D model of the occlusal surface[.]

Ex. 1001, 16:41–61.

For these limitations, Petitioner relies on arguments presented for similar limitations recited in claim 1. *See* Pet. 36–40.

Nonetheless, we determine that Petitioner’s arguments suffer from the same fatal flaws. Namely, claim 10, like claim 1, requires removal of the soft tissue image data from the overlapping images frames that were used to generate the occlusal scan “based at least in part on an analysis of 3D data from the contiguous scan[.]” Ex. 1001, 16:51–57. Presumed in limitation

[10.2] is that the contiguous scan exists and has been generated “by capturing a plurality of partially overlapping image frames of the occlusal surface and stitching the overlapping image frames together to form a 3D model of the occlusal surface.” Ex. 1001, 16:45–50.

As discussed above, Babayoff teaches the stitching together of hard tissue images after the removal of soft tissue image data. Ex. 1008, 5:12–16, 24:29–37, 24:41–47. Thus, Petitioner has not sufficiently explained how Babayoff teaches or suggests these limitations and does not show a reasonable likelihood of prevailing in its challenge against claim 10.

5. Dependent Claims 2–6, 11–15, and 17–19

Claims 2–6 depend from independent claim 1 and claims 11–15 and 17–19 depend from independent claim 10.

Petitioner’s arguments for these dependent claims do not remedy the above discussed deficiencies regarding independent claims 1 and 10. Thus, for the reasons discussed for claims 1 and 10, Petitioner does not show a reasonable likelihood of prevailing in its challenge to claims 2–6, 11–15, and 17–19 based on Zhang and Babayoff.

E. Ground 2: Claims 7 and 16 as Obvious over Zhang in view of Babayoff and further in view of Fisker

1. Fisker (Ex. 1009)

Fisker is a WIPO International Publication titled “Detection of a Movable Object When 3D Scanning a Rigid Object.” Ex. 1009, code (54). Fisker “relates to scanning of a patient’s set of teeth in the mouth of the patient by means of a hand held scanner.” *Id.* at 1:9–10. Fisker discloses a near threshold distance to determine what objects to disregard in an image when generating 3D models of a patient’s mouth. *Id.* at 9:16–10:4. Fisker

describes that this distance depends on the noise present in the images, which causes errors when trying to align scans that may not be completely accurate. *Id.* at 53:17–29.

2. *Dependent Claims 7 and 16*

For dependent claims 7 and 16, Petitioner argues that “Fisker discloses that a processor uses noise characteristics of the image data to detect the overlap in the images.” Pet. 51 (citing Ex. 1009, 9:16–10:4, 38:21–26, 53:17–29, 57:20–22; Ex. 1003 ¶¶ 250–253).

Petitioner’s arguments for dependent claims 7 and 16 do not remedy the above discussed deficiencies regarding independent claims 1 and 10. Thus, for the reasons discussed for claims 1 and 10, Petitioner does not show a reasonable likelihood of prevailing in its challenge to claims 7 and 16 based on Zhang, Babayoff, and Fisker.

F. *Ground 3: Claim 8 as Obvious over Zhang in view of Babayoff and further in view of Dillon*

1. *Dillon (Ex. 1010)*

Dillon is a U.S. Patent Application Publication titled “Method of Data Acquisition for Three-Dimensional Imaging.” Ex. 1010, code (54). Dillon relates to 3D imaging of the intra-oral cavity, and more particularly, to a method of acquiring 3D image data of an object scene using a plurality of 3D measurement scans and generating a complete 3D image from the scans. *Id.* ¶ 2. Dillon discloses that the “embodiments described . . . use structured illumination patterns generated by interferometric fringe projection.” *Id.* ¶ 17.

2. *Dependent Claim 8*

For dependent claim 8, Petitioner relies on Dillon’s purported interferometric fringe teachings. Pet. 55–61. Nonetheless, Petitioner’s arguments for dependent claim 8 do not remedy the above discussed deficiencies regarding independent claim 1. Thus, for the reasons discussed for claim 1, Petitioner does not show a reasonable likelihood of prevailing in its challenge to claim 8 based on Zhang, Babayoff, and Dillon.

G. *Ground 4: Claims 9 and 20 as Obvious over Zhang in view of Babayoff and further in view of Johnson*

1. *Johnson (Ex. 1011)*

Johnson is a Ph.D. Dissertation titled “Spin-Images: A Representation for 3-D Surface Matching.” Ex. 1011, 1. Johnson relates to a data level representation of surfaces used for surface matching, which is the process that compares surfaces and decides whether they are similar. *Id.* Abstract.

2. *Claims 9 and 20*

For dependent claims 9 and 20, Petitioner asserts that Johnson describes “how to use surface normals to distinguish between dissimilar structures in a 3D image and to determine overlaps.” Pet. 61.

Petitioner’s arguments for dependent claims 9 and 20 do not remedy the above discussed deficiencies regarding independent claims 1 and 10. Thus, for the reasons discussed for claims 1 and 10, Petitioner does not show a reasonable likelihood of prevailing in its challenge to claims 9 and 20 based on Zhang, Babayoff, and Johnson.

III. CONCLUSION

Based on the record before us, and for the reasons explained above, we find Petitioner has not demonstrated a reasonable likelihood that it would

prevail with respect to at least one claim challenged in the Petition. Thus, decline to institute *inter partes* review.

IV. ORDER

Upon consideration of the record before us, it is:
ORDERED that the Petition is denied, and no trial is instituted.

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