

**IN THE UNITED STATES DISTRICT COURT
FOR THE NORTHERN DISTRICT OF GEORGIA**

3SHAPE A/S,

Plaintiff,

v.

CARESTREAM DENTAL, LLC,
DENTAL IMAGING
TECHNOLOGIES CORP., and
DENTAL IMAGING
TECHNOLOGIES CORP. d/b/a
DEXIS

Defendants.

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Civil Action No.
1:22-cv-01829-WMR

DEFENDANTS' FIRST SUPPLEMENTAL INVALIDITY CONTENTIONS
(11/07/2022)

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I. INTRODUCTION

Pursuant to Scheduling Order (Dkt. 90) and Local Patent Rule 4.3, Defendants Dental Imagine Technologies Corp. (“DITC”) Dental Imaging Technologies Corp. d/b/a DEXIS (“DEXIS”), and Carestream Dental, LLC (“Carestream”) (collectively, “Defendants”), by and through their undersigned attorneys, hereby serve on 3Shape A/S (“3Shape” or “Plaintiff”) their First Supplemental Preliminary Invalidity Contentions regarding U.S. Patent No. RE48,221 (“the ’221 patent”), U.S. Patent No. 11,076,146 (“the ’146 patent”), U.S. Patent No. 10,695,151 (“the ’151 patent”), and U.S. Patent No. 11,368,667 (“the ’667 patent”) (collectively, the “Asserted Patents”).

The table below summarizes the claims asserted by 3Shape in this case (the “Asserted Claims”). Defendants provide their First Supplemental Preliminary Invalidity Contentions only for the Asserted Claims and reserve all rights to supplement and/or amend these First Supplemental Preliminary Invalidity Contentions to the extent 3Shape is permitted to assert additional claims.

Asserted Patent	Asserted Claims
RE48,221	1-3, 5, 9-11, 19-28, 30, 31, 33, and 34
11,076,146	1-6, 8-13, 15, 20-27, and 29
10,695,151	1-3, 6, 7, and 9-17
11,368,667	1-3, 5-8, 12-20, 22, 26-29

II. GENERAL RESERVATIONS

These contentions are subject to the reservations stated herein and are subject to revision and amendment, including pursuant to Rule 26(e) of the Federal Rules of Civil Procedure and any orders of the Court, to the extent appropriate in light of further investigation and discovery regarding the defenses asserted by Defendants; the Court's claim construction related to the Asserted Claims; analyses and opinions of expert witnesses concerning claim construction, infringement, invalidity, and unenforceability issues; and/or positions that 3Shape may take concerning the same.

These First Supplemental Preliminary Invalidity Contentions and Defendants' accompanying production of documents are provisional and subject to further revision including as follows: Defendants reserve the right to amend these contentions should 3Shape provide any information that it failed to provide in its disclosures or should 3Shape amend its disclosures in any way. Further, because discovery has just begun, Defendants reserve the right to revise, amend, and/or supplement the information provided herein, including the accompanying document production, as additional information becomes available during the course of this case.

Prior art not included in these First Supplemental Preliminary Invalidity Contentions, whether known or not known to Defendants, may become relevant. In particular, if and to the extent 3Shape contends any limitations of the Asserted

Claims are not disclosed in the prior art identified herein, Defendants reserve the right to identify other references that disclose and/or render obvious any such allegedly missing limitations of any claims and those claims as a whole. Defendants incorporate, in full, and reserve the rights to rely on all prior art references cited in the Asserted Patents and any patents to which the Asserted Patents claim priority, the Asserted Patents' respective prosecution histories, and any other reference identified in connection with this action.

Defendants' positions on the invalidity of the Asserted Claims will depend in part on how those claims are construed by the Court. Because claim construction has not yet occurred, Defendants cannot yet take a final position on the bases for invalidity of the Asserted Claims because the Court may construe those claims to mean something different from what Defendants assume them to mean for purposes of these First Supplemental Preliminary Invalidity Contentions. Defendants offer these First Supplemental Preliminary Invalidity Contentions in response to 3Shape's Preliminary Infringement Contentions and base them at least in part upon the claim scope and certain claim constructions that apparently are asserted or adopted by 3Shape, as evidenced, for example, in 3Shape's Preliminary Infringement Contentions. Defendants dispute 3Shape's apparent claim constructions, but apply them herein in order to identify the potentially relevant prior art known to Defendants. Defendants offer these contentions without prejudice to any position

they may ultimately take as to any claim construction issues. To the extent these First Supplemental Preliminary Invalidity Contentions reflect constructions of claim limitations consistent with or implicit in 3Shape's Preliminary Infringement Contentions, no implication is intended nor should any inference be drawn that Defendants agree with 3Shape's claim constructions, and Defendants expressly reserve the right to contest such claim constructions. Nothing herein should be construed or represented as evidencing any express or implied agreement with any of 3Shape's claim construction or infringement positions. By applying any of 3Shape's apparent claim constructions herein, Defendants do not concede in any way that those constructions are correct. 3Shape is estopped for the purposes of invalidity from denying that a product it accuses of infringement does not, if that product is prior art, invalidate all claims the product is asserted to infringe. At least under 3Shape's apparent infringement theories, all of the elements underlying the alleged invention of the Asserted Claims were already known or obvious before the respective alleged priority date of each of the Asserted Patents as alleged in the Infringement Contentions. Defendants expressly reserve the right to oppose those constructions and contentions at the appropriate time.

Defendants further intend to rely on admissions concerning the scope of the prior art relevant to the Asserted Patents found in, *inter alia*: the patent prosecution history for the Asserted Patents and any related patents and/or patent applications;

any deposition testimony of the named inventor(s) on the Asserted Patents and any related patents and/or patent applications in this action or any other action; and the papers filed and any evidence submitted by 3Shape in connection with this action.

Defendants' claim charts cite to particular teachings and disclosures of the prior art as applied to features of the Asserted Claims. However, persons having ordinary skill in the art generally may view an item of prior art in the context of other publications, literature, products, and understanding. As such, the cited portions are only examples, and Defendants reserve the right to rely on uncited portions of the prior art references and on other publications, expert testimony, and other evidence as aids in understanding and interpreting the cited portions, as providing context thereto, and as additional evidence that the prior art discloses a claim limitation or any of the Asserted Claims as a whole. Defendants further reserve the right to rely on uncited portions of the prior art references, other publications, and testimony, including expert testimony, to establish bases for combinations of certain cited references that render the Asserted Claims obvious. Defendants reserve the right to present additional items of prior art under 35 U.S.C. §§ 102(a), (b), (e), and/or (g), and/or § 103, located during the course of such discovery or further investigation, and to assert invalidity under 35 U.S.C. §§ 102(c), (d), or (f), to the extent that such discovery or investigation yields information forming the basis for such invalidity. Defendants have only received limited discovery from 3Shape. Depositions of the

named inventors, for instance, will likely reveal information that affects the disclosures and contentions herein. Defendants have not yet received discovery from third parties who may have information concerning additional prior art. Such discovery may also reveal information that affects the disclosures and contentions herein. In particular, for prior art patents and publications identified in these First Supplemental Preliminary Invalidity Contentions, Defendants reserve the right to rely on the public use, offer for sale, sale, and/or actual products embodying the methods and systems described therein uncovered during discovery.

Defendants reserve the right to serve additional or modified invalidity contentions if 3Shape asserts or is found to be entitled to priority dates different from those upon which 3Shape currently asserts.

Defendants further reserve the right to modify or add contentions in the event that 3Shape provides amended infringement contentions and to the extent the Court orders or allows 3Shape to amend its infringement contentions.

The references discussed in the claim charts may disclose the elements of the Asserted Claims explicitly and/or inherently, and/or they may be relied upon to show the state of the art in the relevant time frame. Any obviousness combinations are provided in addition and in the alternative to Defendants' anticipation contentions and are not to be construed as an admission or suggestion that any reference included in the combinations does not by itself anticipate.

Defendants reserve the right to assert that the Asserted Claims are invalid under 35 U.S.C. § 102(f) in the event Defendants obtain evidence that the inventor named in the Asserted Patents did not himself invent the subject matter claimed in the respective patents, or that any of the Asserted Patents otherwise fails to name the correct inventor(s). Should Defendants obtain such evidence, it will provide the name of any person from whom, and the circumstances under which, the alleged invention or any part of it was derived, or the name of any person who Defendants contends is inappropriately named or not named as an inventor.

Defendants also reserve the right to challenge any terms of any Asserted Claims under 35 U.S.C. § 112 beyond the grounds outlined herein, including by arguing that they are indefinite, not supported by the written description, or not enabled. Nothing stated herein shall be construed as a waiver of any argument available under 35 U.S.C. §§ 101, 102, 103, and/or 112.

III. PRIOR ART

Subject to Defendants' reservation of rights in these First Supplemental Preliminary Invalidity Contentions, Defendants identify in the tables below each known prior art reference that anticipates and/or renders obvious, alone and/or in combination with one or more other references, any of the Asserted Claims of the Asserted Patents. For each prior art reference, the table provides the identity of the reference, the country in which it was available, and the dates of filing, publication,

and/or issuance, as appropriate and to the extent known based on presently available information. The references identified in the tables constitute prior art under one or more of pre-AIA 35 U.S.C. § 102(a), (b), and (e) and/or AIA 35 U.S.C. § 102(a)(1) and/or (a)(2), and/or 35 U.S.C. § 103.

Discovery is ongoing, and Defendants' prior art investigation and third-party discovery is not yet complete. The lists below are thus neither exclusive nor exhaustive. Defendants reserve the right to rely not only on the references listed below but also on other art that may become known and/or relevant during the course of discovery. For example, Defendants expect to receive, either via informal request or pursuant to subpoena, documents from third parties who are believed to have knowledge, documentation, and/or corroborating evidence concerning prior art listed in these tables and/or additional prior art. These third parties include, as applicable and without limitation, the authors, inventors, assignees, and/or licensees of the references listed in these disclosures. Any citation to one or more of these or other prior art references relating to any method or apparatus should be construed to constitute not only a citation to the prior art reference itself but also a reference to the disclosed method or apparatus.

Each prior art patent or publication identified below that was either filed or issued (for patents) or published (for publications) before the earliest claimed priority date of the corresponding Asserted Patent does not appear to have been

abandoned, suppressed, or concealed, so each such reference also constitutes evidence of prior invention pursuant to 35 U.S.C. § 102(g) to the extent that it is in the U.S. The persons or entities involved with each such invention include the named inventors on the above-identified patents and the authors listed on the above-identified publications.

Defendants incorporate the prior art references cited in IPR2018-00197, IPR2018-00198, IPR2022-00144, IPR2022-00145, and any other Inter Partes Review (IPR) of the Asserted Patents, whether instituted or not.

Defendants further incorporate, in full, the invalidity contentions and prior art disclosed by defendants in other 3Shape Litigation, including, for example, *Align Technology, Inc. v. 3Shape A/S*, case number 6-20-cv-00979 pending in the Western District of Texas.

A. ‘221 Patent

Table 1: Prior art patent and printed publication to the ’221 Patent

Country	Patent No./Publication No./Printed Publication	Filing/Publication/Issue Date	Inventor(s)/Author(s)	Prior Art Status
US	2007/0171220	July 26, 2007	Kriveshko	102(b)
US	2006/0020204	January 26, 2006	Serra	102(b)
US	2005/0212756	September 29, 2005	Marvit	102(b)
US	8,903,476	March 8, 2009	Brennan	102(e)
US	2006/0212260	September 21, 2006	Kopelman	102(b)
USP	2007/0172112	July 26, 2007	Paley	102(b)
US	2009/0322676	May 1, 2008	Kerr	102(b)
PCT	2010/064156	June 10, 2010	Poland	102(e)
US	2005/0237581	October 27, 2005	Knighton	102(b)
US	2009/0298017	December 3, 2009	Boerjes	102(b)
US	2009/0087050	April 2, 2009	Gandyra	102(b)

US	2005/0020910	January 27, 2005	Quadling	102(b)
US	2012/0179035	July 12, 2012	Boudier	102(e)
US	8,914,245	March 20, 2009	Hopkins	102(e)
US	6,975,898	December 13, 2005	Seibel	102(b)
PCT	WO 2010/106379	March 22, 2010	Hopkins2	102(e)
US	7,184,150	February 27, 2007	Quadling2	102(b)
US	7,494,338	February 24, 2009	Durbin	102(b)
US	2007/0064242	March 22, 2007	Childers	102(b)
US	2007/0016025	January 18, 2007	Arenson	102(b)
US	2009/0291417	November 26, 2009	Rubbert	102(b)
US	2008/0071143	March 20, 2008	Gattani	102(b)
US	2009/0097108	April 16, 2009	Fox	102(b)
PCT	WO 2009/034157	March 19, 2009	Ertl	102(b)
US	9,554,692	June 18, 2009	Levy	102(e)
US	9,554,857	September 14, 2009	Toledo-Crow	102(e)
US	2008/0058783	March 6, 2008	Altshuler	102(b)
US	2008/0132886	June 5, 2008	Cohen	102(b)
PCT	WO 2009/026645	March 5, 2009	Bartlett	102(b)
JP	2008194108	August 28, 2008	Masami	102(b)
	Laser Beam Used in Dental Scanning for CAD/CAM Technologies	2007	Sinescu	102(b)
	Dental Impressions Using 3D Digital Scanners: Virtual Becomes Reality	October 2008	Birnbaum	102(b)
	Using a Wireless Motion Controller for 3D Medical Image Catheter Interactions	2009	Vitanovski	102(b)
US	8,313,379	September 24, 2010	Ikeda	102(a)/(e)
US	7,840,042	November 23, 2010	Kriveshko2	102(a)
US	2008/0194928	August 14, 2008	Bandic	102(b)
US	8,625,854	January 7, 2014	Valkenburg	102(a)/(e)
US	9,402,601	August 2, 2016	Berger	102(a)
US	7,215,430	May 8, 2007	Kacyra	102(b)
US	7,474,414	January 6, 2009	Bae	102(b)
US	2007/0182812	August 9, 2007	Ritchey	102(b)
US	2009/0177050	July 9, 2009	Griffiths	102(b)
US	6,251,073	June 26, 2001	Imran	102(b)
US	2008/0194950	August 14, 2008	Mejia	102(b)
	Merging Virtual Objects with the Real World: Seeing Ultrasound Imagery within the Patient	July 1992	Bajura	102(b)

In addition, Defendants identify the following prior art apparatuses/systems (“System Prior Art”) that are understood to be prior art under pre-AIA 35 U.S.C. § 102(a), (b), and/or (g) and/or AIA 35 U.S.C. § 102(a)(1):

- Cerec by Sirona Dental System GmbH
- Itero by Cadent Ltd.
- E4D by D4D Technologies LLC
- Lava C.O.S. by 3M Espe
- IOS FastScan by IOS Technologies, Inc.
- Densys3D by Densys Ltd.
- DPI-3D by Dimensional Photonics International, Inc.
- 3D Progress by MHT S.P.A., MHT Optic Research AG
- directScan by HINT-ELS GmbH
- Wii by Nintendo
- Clearmatch by Clarity Dental
- CrystalEye by Olympus America
- EasyShade Compact by Vident
- Shade-X by X-Rite
- ShadeVision by X-Rite
- SpectroShade Micro by MHT.
- ShadeScan by CYNOVAD Inc.
- Shade Analyzer by Shade Analyzing Technologies, Inc.
- 3D-Master Shade System by VITAPAN

B. ‘151 Patent

Table 2: Prior art patent and printed publication to the ‘151 Patent

Country	Patent No./Publication No./Printed Publication	Filing/Publication/Issue Date	Inventor/Author	Prior Art Status
US	7,698,068	April 13, 2010	Babayoff2	102(a)
US	2005/0074718	April 7, 2005	Graham	102(a)
WO	2010/145669	December 23, 2010	Fisker	102(a)

	Dental Color Matching Instrument and Systems. Review of Clinical and Research Aspects	2010	Chu	102(a)
US	2011/0188726	August 4, 2011	Nathaniel	102(a)
US	6,249,616	June 19, 2001	Hashimoto	102(a)
US	6,575,751	June 10, 2003	Lehman	102(a)
US	2005/0283065	December 22, 2005	Babayoff3	102(a)
US	7,708,557	May 4, 2010	Rubbert5	102(a)
US	7,762,814	July 27, 2010	van der Zel	102(a)
US	8,092,215	January 10, 2012	Stone-Collonge	102(a)
US	8,442,283	May 14, 2013	Choi	102(a)
US	2013/0244197	September 19, 2013	Tjioe	102(a)
US	2012/0015316	January 19, 2012	Sachdeva2	102(a)
US	2014/0022356	January 23, 2014	Fisker2	102(a)
US	2013/0158694	June 20, 2013	Rubbert6	102(a)
US	10,111,714	January 27, 2014	Kopelman	102(a)(2)
US	2004/0185422	September 23, 2004	Orth	102(a)
US	2013/0034823	February 7, 2013	Liang3	102(a)
US	2010/0201986	August 12, 2010	Inglese	102(a)
US	2014/0146142	May 29, 2014	Duret	102(a)(2)
PCT	WO 2012/083960	June 27, 2012	Fisker4	102(a)
DE	DE 19642247	October 12, 1996	Meller	102(a)
US	8,400,635	March 19, 2013	Inglese2	102(a)
US	8,848,991	March 16, 2012	Tjioe2	102(a)(2)
US	8,386,061	February 26, 2013	Violante	102(a)
US	7,086,863	August 8, 2006	van der Zel2	102(a)
US	8,026,916	September 27, 2011	Wen	102(a)
	Dental Shade Matching Using a Digital Camera	June 9, 2012	Tam	102(a)
US	8,828,287	March 25, 2009	van der Zel3	102(a)(2)
US	9,827,076	December 22, 2011	Korten	102(a)(2)
US	6,072,496	June 6, 2000	Guenter	102(a)
US	9,173,727	July 6, 2007	Yamamoto	102(a)(2)
US	8,469,705	June 25, 2013	Sachdeva3	102(a)
US	5,766,006	June 16, 1998	Murlijacic	102(a)
	Color and Shade Management in Esthetic Dentistry	December 1, 2013	Agrawal	102(a)

	Shade Matching Assisted by Digital Photography and Computer Software	January 1, 2009	Schropp	102(a)
US	9,662,188	February 14, 2011	Laubersheimer	102(a)(2)
US	9,861,457	March 20, 2009	Fisker3	102(a)(2)
US	2007/0026363	February 1, 2007	Lehmann	102(a)(2)
US	6,743,014	June 1, 2004	Kerschbaumer	102(a)
	Digital Pictures: Representation and Compression (Applications of Communications Theory)	1988	Netravali	102(a)
US	6,206,691	March 27, 2001	Lehmann2	102(a)
US	8,570,530	October 29, 2013	Liang	102(a)
US	8,532,355	September 10, 2013	Quadling	102(a)
US	7,946,845	May 24, 2013	Lehmann3	102(a)
US	7,522,322	April 21, 2009	Blanding	102(a)
US	9,208,531	December 8, 2015	Boerjes	102(a)(2)
US	2007/0140539	June 21, 2007	Katsumata	102(a)
US	7,929,151	April 19, 2011	Liang2	102(a)
US	6,007,332	December 28, 1999	O'Brien	102(a)
US	8,532,355	September 10, 2013	Quadling	102(a)
DE	102009023952	September 12, 2010	Raimund	102(a)
US	8,571,281	October 29, 2013	Wong	102(a)
US	8,208,704	June 26, 2012	Wong2	102(a)
EP	2620733	January 27, 2012	Brotzge	

In addition, Defendants identify the following prior art apparatuses/systems (“System Prior Art”) that are understood to be prior art under pre-AIA 35 U.S.C. § 102(a), (b), and/or (g) and/or AIA 35 U.S.C. § 102(a)(1):

- Cerec by Sirona Dental System GmbH
- Itero by Cadent Ltd.
- E4D by D4D Technologies LLC
- Lava C.O.S. by 3M Espe
- IOS FastScan by IOS Technologies, Inc.
- Densys3D by Densys Ltd.

- DPI-3D by Dimensional Photonics International, Inc.
- 3D Progress by MHT S.P.A., MHT Optic Research AG
- directScan by HINT-ELS GmbH
- Clearmatch by Clarity Dental
- CrystalEye by Olympus America
- EasyShade Compact by Vident
- Shade-X by X-Rite
- ShadeVision by X-Rite
- SpectroShade Micro by MHT
- ShadeScan by CYNOVAD Inc.
- Shade Analyzer by Shade Analyzing Technologies, Inc.
- 3D-Master Shade System by VITAPAN

C. '146 Patent

Table 3: Prior art patent and printed publication to the '146 Patent

Country	Patent No./Publication No./Printed Publication	Filing/Publication/Issue Date	Inventor(s)/Author(s)	Prior Art Status (pre-AIA)
US	5,850,289	December 15, 1998	Fowler	102(b)
US	5,851,113	December 22, 1998	Jung	102(b)
US	6,532,299	March 11, 2003	Sachdeva	102(b)
US	6,761,561	July 13, 2004	Mandelkern	102(b)
US	6,977,732	December 20, 2005	Chen	102(b)
US	7,058,213	June 6, 2006	Rubbert2	102(b)
US	7,385,708	June 10, 2008	Ackerman	102(b)
US	2005/0090749	April 28, 2005	Rubbert3	102(b)
PCT	WO 2009/063088	May 26, 2009	Pfeiffer	102(a)
US	8,570,530	June 3, 2009	Liang	102(e)/(g)
US	2005/0243330	November 3, 2005	Magarill	102(b)
US	2009/0076321	December 11, 2007	Suyama	102(a)/(e)
US	2010/0268069	April 16, 2009	Liang2	102(e)
US	2011/0316978	May 20, 2009	Dillon	102(e)
PCT	WO 2001/84479	November 8, 2001	Rubbert4	102(b)
PCT	WO 1988/07695	October 6, 1988	Kino	102(b)
US	5,737,084	April 7, 1998	Isihara	102(b)
	Confocal Microscopy through A Fiber-	April 15, 1993	Gmitro	102(b)

	optic Imaging Bundle			
	Theoretical Analysis of Confocal Microscopy with Microlenses	January 1, 1996	Tiziani	102(b)
	A 3-Dimensional Vision System For Dental Application	August 23-25, 2007	Zhang	102(b)
US	2008/0024768	January 31, 2008	Babayoff	102(b)
US	2009/0087050	August 18, 2008	Gandyra	102(a)/(e)
US	2005/0237581	October 27, 2005	Knighton	102(b)
US	9,262,864	June 27, 2008	Rohaly	102(b)
US	7,184,150	February 27, 2007	Quadling2	102(b)
US	2003/0043089	March 6, 2003	Hanson	102(b)
US	8,280,152	November 14, 2008	Thiel	102(e)
US	8,532,355	November 7, 2008	Quadling3	102(e)
	Real-time three-dimensional imaging of macroscopic structures	August 1998	Wilson	102(b)
US	5,381,236	January 10, 1995	Morgan	102(b)
PCT	WO 98/45745	October 15, 1998	Wilson2	102(b)
US	2006/0072123	April 6, 2006	Wilson3	102(b)
	Confocal Microscopy by Aperture Correlation	December 1, 1996	Wilson4	102(b)
PCT	WO 03/060587	July 24, 2003	Plamann	102(b)
US	7,460,248	May 15, 2006	Kurtz	102(a)/(e)
US	7,068,825	June 27, 2006	Rubbert5	102(b)
	3D Shape Reconstruction of Teeth by Shadow Speckle Correlation Method	June 29, 2005	Gao	102(b)
US	7,339,170	March 4, 2008	Deliwala	102(b)
US	4,802,759	February 7, 1989	Matsumoto	102(b)
US	7,929,751	October 11, 2005	Zhang2	102(a)/(e)
US	2009/0061381	September 5, 2007	Durbin	102(a)
US	6,751,344	June 15, 2004	Grumbine	102(b)
US	8,390,821	March 5, 2013	Schpunt	102(a)/(e)

PCT	WO 1997/014932	April 24, 1997	Aahlen	102(b)
	3D Orthognathic Surgery Simulation Using Image Fusion	May 2009	Schendel	102(a)
US	2004/0151369	August 5, 2004	Schwotzer	102(b)
US	2001/9938705	November 8, 2001	Rubbert6	102(b)
US	2005/0088529	April 28, 2005	Geng	102(b)
	Tele-3D – Developing a Handheld Scanner Using Structured Light Projection	June 19-21, 2002	Ferreira	102(b)
US	2009/0021745	January 22, 2009	Tamura	102(a)
US	2009/0092955	April 9, 2009	Hwang	102(a)
US	2008/0018598	January 24, 2008	Marsden	102(b)
	Dense 3-D Surface Acquisition by Structured Light Using Off-The-Shelf Components	December 22, 2000	Guhring	102(b)
	Installation and Operation Instructions Durr VISTACAM, VISTACAM CL 2016	November 2004	VISTACAM	102(b)
	Miniaturized 3D surface profilometer using digital fringe projection	March 22, 2005	Chen	102(b)
	Intraoral 3D Scanner	October 10, 2007	Kuhmstedt	102(b)
US	2010/0253773	April 7, 2009	Oota	102(a)
US	2007/0172101	July 26, 2007	Kriveshko2	102(b)
	The Concept of Virtual Landmarks in 3D Multi-View Fringe Projection	October 11, 2007	Notni	102(b)
US	2007/0171220	July 26, 2007	Kriveshko	102(b)
US	2006/0020204	January 26, 2006	Serra	102(b)
US	2005/0212756	September 29, 2005	Marvit	102(b)
US	8,914,245	March 20, 2009	Hopkins	102(e)
US	2008/0071143	March 20, 2008	Gattani	102(b)

In addition, Defendants identify the following prior art apparatuses/systems (“System Prior Art”) that are understood to be prior art under pre-AIA 35 U.S.C. § 102(a), (b), and/or (g) and/or AIA 35 U.S.C. § 102(a)(1):

- Cerec by Sirona Dental System GmbH
- Itero by Cadent Ltd.
- E4D by D4D Technologies LLC
- Lava C.O.S. by 3M Espe
- IOS FastScan by IOS Technologies, Inc.
- Densys3D by Densys Ltd.
- DPI-3D by Dimensional Photonics International, Inc.
- 3D Progress by MHT S.P.A., MHT Optic Research AG
- directScan by HINT-ELS GmbH
- Clearmatch by Clarity Dental
- CrystalEye by Olympus America
- EasyShade Compact by Vident
- Shade-X by X-Rite
- ShadeVision by X-Rite
- SpectroShade Micro by MHT.
- ShadeScan by CYNOVAD Inc.
- Shade Analyzer by Shade Analyzing Technologies, Inc.
- 3D-Master Shade System by VITAPAN

D. ’667 Patent

Table 4: Prior art patent and printed publication to the ’667 Patent

Country	Patent No./Publication No./Printed Publication	Filing/Publication/Issue Date	Inventor(s)/Author(s)	Prior Art Status (pre-AIA)
US	5,850,289	December 15, 1998	Fowler	102(b)
US	5,851,113	December 22, 1998	Jung	102(b)
US	6,532,299	March 11, 2003	Sachdeva	102(b)
US	6,761,561	July 13, 2004	Mandelkern	102(b)
US	6,977,732	December 20, 2005	Chen	102(b)
US	7,058,213	June 6, 2006	Rubbert2	102(b)

US	7,385,708	June 10, 2008	Ackerman	102(b)
US	2005/0090749	April 28, 2005	Rubbert3	102(b)
PCT	WO 2009/063088	May 26, 2009	Pfeiffer	102(a)
US	8,570,530	June 3, 2009	Liang	102(e)/(g)
US	2005/0243330	November 3, 2005	Magarill	102(b)
US	2009/0076321	December 11, 2007	Suyama	102(a)/(e)
US	2010/0268069	April 16, 2009	Liang2	102(e)
US	2011/0316978	May 20, 2009	Dillon	102(e)
PCT	WO 2001/84479	November 8, 2001	Rubbert4	102(b)
PCT	WO 1988/07695	October 6, 1988	Kino	102(b)
US	5,737,084	April 7, 1998	Isihara	102(b)
	Confocal Microscopy through A Fiber-optic Imaging Bundle	April 15, 1993	Gmitro	102(b)
	Theoretical Analysis of Confocal Microscopy with Microlenses	January 1, 1996	Tiziani	102(b)
	A 3-Dimensional Vision System For Dental Application	August 23-25, 2007	Zhang	102(b)
US	2008/0024768	January 31, 2008	Babayoff	102(b)
US	2009/0087050	August 18, 2008	Gandyra	102(a)/(e)
US	2005/0237581	October 27, 2005	Knighton	102(b)
US	9,262,864	June 27, 2008	Rohaly	102(b)
US	7,184,150	February 27, 2007	Quadling2	102(b)
US	2003/0043089	March 6, 2003	Hanson	102(b)
US	8,280,152	November 14, 2008	Thiel	102(e)
US	8,532,355	November 7, 2008	Quadling3	102(e)
	Real-time three-dimensional imaging of macroscopic structures	August 1998	Wilson	102(b)
US	5,381,236	January 10, 1995	Morgan	102(b)
PCT	WO 98/45745	October 15, 1998	Wilson2	102(b)
US	2006/0072123	April 6, 2006	Wilson3	102(b)
	Confocal Microscopy by Aperture Correlation	December 1, 1996	Wilson4	102(b)
PCT	WO 03/060587	July 24, 2003	Plamann	102(b)

US	7,460,248	May 15, 2006	Kurtz	102(a)/(e)
US	7,068,825	June 27, 2006	Rubbert5	102(b)
	3D Shape Reconstruction of Teeth by Shadow Speckle Correlation Method	June 29, 2005	Gao	102(b)
US	7,339,170	March 4, 2008	Deliwala	102(b)
US	4,802,759	February 7, 1989	Matsumoto	102(b)
US	7,929,751	October 11, 2005	Zhang2	102(a)/(e)
US	2009/0061381	September 5, 2007	Durbin	102(a)
US	6,751,344	June 15, 2004	Grumbine	102(b)
US	8,390,821	March 5, 2013	Schpunt	102(a)/(e)
PCT	WO 1997/014932	April 24, 1997	Aahlen	102(b)
	3D Orthognathic Surgery Simulation Using Image Fusion	May 2009	Schendel	102(a)
US	2007/0171220	July 26, 2007	Kriveshko	102(b)
US	2006/0020204	January 26, 2006	Serra	102(b)
US	2005/0212756	September 29, 2005	Marvit	102(b)
US	8,914,245	March 20, 2009	Hopkins	102(e)
US	2008/0071143	March 20, 2008	Gattani	102(b)
US	2001/9938705	November 8, 2001	Rubbert6	102(b)
US	2005/0088529	April 28, 2005	Geng	102(b)
	Tele-3D – Developing a Handheld Scanner Using Structured Light Projection	June 19-21, 2002	Ferreira	102(b)
US	2009/0021745	January 22, 2009	Tamura	102(a)
US	2009/0092955	April 9, 2009	Hwang	102(a)
US	2008/0018598	January 24, 2008	Marsden	102(b)
	Dense 3-D Surface Acquisition by Structured Light Using Off-The-Shelf Components	December 22, 2000	Guhring	102(b)
	Installation and Operation Instructions Durr VISTACAM, VISTACAM CL 2016	November 2004	VISTACAM	102(b)

	Miniaturized 3D surface profilometer using digital fringe projection	March 22, 2005	Chen	102(b)
	Intraoral 3D Scanner	October 10, 2007	Kuhmstedt	102(b)
US	2010/0253773	April 7, 2009	Oota	102(a)
US	2007/0172101	July 26, 2007	Kriveshko2	102(b)
	The Concept of Virtual Landmarks in 3D Multi-View Fringe Projection	October 11, 2007	Notni	102(b)

In addition, Defendants identify the following prior art apparatuses/systems (“System Prior Art”) that are understood to be prior art under pre-AIA 35 U.S.C. § 102(a), (b), and/or (g) and/or AIA 35 U.S.C. § 102(a)(1):

- Cerec by Sirona Dental System GmbH
- Itero by Cadent Ltd.
- E4D by D4D Technologies LLC
- Lava C.O.S. by 3M Espe
- IOS FastScan by IOS Technologies, Inc.
- Densys3D by Densys Ltd.
- DPI-3D by Dimensional Photonics International, Inc.
- 3D Progress by MHT S.P.A., MHT Optic Research AG
- directScan by HINT-ELS GmbH
- Wii by Nintendo
- Clearmatch by Clarity Dental
- CrystalEye by Olympus America
- EasyShade Compact by Vident
- Shade-X by X-Rite
- ShadeVision by X-Rite
- SpectroShade Micro by MHT.
- ShadeScan by CYNOVAD Inc.
- Shade Analyzer by Shade Analyzing Technologies, Inc.
- 3D-Master Shade System by VITAPAN

IV. 35 U.S.C. § 102

Subject to Defendants’ reservation of rights in these First Supplemental Preliminary Invalidity Contentions, and based on Defendants’ present understanding of the Asserted Claims and the apparent constructions 3Shape is asserting in view of 3Shape’s Preliminary Infringement Contentions, the prior art references identified below in Tables 5 through 8 each anticipate each of the Asserted Claims of the respective Asserted Patents, as shown by the claim charts included in the corresponding exhibits indicated.

Table 5: Anticipatory Prior Art to the ’221 Patent

Chart	Prior Art	Inventor(s)/Author(s)
221-1	2008/0071143	Gattani
221-2	8,625,854	Valkenburg
221-3	2007/0171220	Kriveshko

Table 6: Anticipatory Prior Art to the ’151 Patent

Chart	Prior Art	Inventor(s)/Author(s)
151-1	2007/0026363	Lehmann
151-2	6,206,691	Lehmann2
151-3	6,743,014	Kerschbaumer
151-4	“Dental color matching instruments and systems. Review of clinical and research aspects.”	Chu
151-5	2010/0201986	Inglese

Table 7: Anticipatory Prior Art to the ’146 Patent

Chart	Prior Art	Inventor(s)/Author(s)
146-1	2008/0024768	Babayoff
146-2	8,570,530	Liang

146-3	2001/0038705	Rubbert6
146-4	2005/0088529	Geng

Table 8: Anticipatory Prior Art to the '667 Patent

Chart	Prior Art	Inventor(s)/Author(s)
667-1	2008/0024768	Babayoff
667-2	8,570,530	Liang
667-3	2001/0038705	Rubbert6
667-4	2005/0088529	Geng

Depending on the Court's construction of the Asserted Claims of the Asserted Patents, and/or positions that 3Shape or its expert witnesses may take concerning claim construction, infringement, and/or invalidity issues, different ones of the charted prior art references in the accompanying exhibits may be of greater or lesser relevance, and different combinations of these references may be implicated. Accordingly, the claim charts may reflect alternative applications of the prior art against the Asserted Claims.

Though these claim charts provide citations to point out where in the prior art references each element may be found, these citations are illustrative only. The references may contain other, uncited disclosures of a given claim element, and Defendants reserves the right to rely also on such other, uncited portions of these references.

The prior art cited in these exhibits is also illustrative, not exhaustive. Defendants' discovery into the prior art is ongoing, including, for example, into the

System Prior Art and other intraoral scanners that were publicly available before the earliest possible priority date of one or more of the Asserted Claims. Based on presently available information, Defendants contend that one or more such products discloses the physical and mechanical properties recited in the Asserted Claims and therefore both anticipates one or more of the Asserted Claims and renders obvious all Asserted Claims, alone and/or in combination with other prior art identified in Tables 1-4.

V. 35 U.S.C. § 103

A. The '221 Patent

1. Combinations

The charts identified above in Table 5 and the chart included in Exhibit 221-B (collectively, '221 Patent Claim Charts) set forth the bases for obviousness, identifying the disclosures of each reference that can be combined on a limitation-by-limitation basis with disclosures from other references (including the ones identified in Table 5 and in Exhibit 221-B). Each of the '221 Patent Claim Charts demonstrates that the charted references render obvious, based on its disclosure alone or in combination with the knowledge of person of skill in the art or with other charted reference(s), each asserted claim of the '221 patent. Exhibit 221-B identifies numerous disclosures in additional prior art references, any of which would be obvious to combine with one or more of the prior art references charted in the '221 Patent Claim Charts in a predictable way with a reasonable expectation of success

to render obvious the claimed invention at issue, to the extent such primary reference is missing the disclosed limitation. Defendants further incorporate all prior art asserted against the '221 patent during its reissue proceedings as well as all prior art asserted against the '221 patent's predecessor patent (U.S. Patent No. 9,329,675 ("the '675 Patent")) in *Align Technology Inc. v. 3Shape A/S*, IPR2018-00197.

Specifically, if Plaintiff argues that any particular prior art reference lacks any claimed feature, a person of ordinary skill in the art as of the '221 patent's purported invention date would have been motivated to modify the reference to include the allegedly missing claimed feature, or to combine it with other references that include that claimed feature, as disclosed in the aforementioned exhibits. As further discussed in Section V.A.2 below, additional exemplary motivations to combine applicable to each limitation for each of the charted references include the following:

- 1. The charted prior art references are in the same field of endeavor as the '221 patent.** The charted prior art references and the '221 patent generally relate to a method and a system comprising a handheld device and at least one display. The scanner further comprises a user interface that can be interacted with via the use of actuators or gestures. Such actuators and gestures can be used to manipulate certain aspects of the display.
- 2. Several of the prior art references have already been found to invalidate the claims of the '221's predecessor patent (U.S. Patent No. 9,329,675 ("the '675 Patent")).** On May 29, 2019, the PTAB ("Board") canceled all claims of the '675 patent in IPR2018-00197. *See Align Technology Inc. v. 3Shape A/S*, IPR2018-00197, Final Written Decision, Paper No. 22 (May 29, 2019). Rather than appeal that decision, on July 30, 2019, 3Shape filed a reissue application, culminating in issuance of the subject '221 patent on September 22,

2020. For example, the Board found that Kriveshko anticipates claims 1, 2, 9-11, and 18 of the '675 patent; Kriveshko and Serra render claims 1-5, 8-11, and 14-19 of the '675 patent as obvious; Serra invalidated claim 19; and Kriveshko, Serra and Brennan rendered claims 6, 7, 12, and 13 obvious.

3. **The charted prior art references are aimed at solving the same perceived problem as the '221 patent.** The charted prior art references and the '221 patent are generally aimed at improving scanning systems that require user interfaces to control, including improving features such as “displaying and inspecting 3D information” and providing “touchless interactive system[s]” to reduce the risk of cross-contamination. '221 patent at 1:19-52.
4. **The charted prior art references use similar techniques to solve the same problems.** The charted prior art references generally teach one or more of the same techniques, namely (a) a handheld device for optically scanning a 3D environment, (b) at least one display remotely connected to the handheld device that is adapted for visually representing the physical 3D environment, (c) the handheld device featuring a 3D user interface for remotely controlling the display, and (d) the handheld device featuring a motion sensor for remotely controlling the display view. One of ordinary skill, with knowledge of each of these references, would understand that any feature or function set forth in one of these references could be exchanged or added to the teachings of another with a reasonable expectation of such (and minimal or no hardware changes).
5. **Combining any charted prior art reference with one or more of the other charted prior art references would have been a predictable combination.** It would have been entirely predictable to a person of ordinary skill in the art at the time of the alleged invention to combine any of the charted prior art references with one or more of the other charted prior art references. As mentioned, all of these references are in the scanning system featuring a display space and disclose similar designs. Given the finite number of identified, predictable solutions in the scanner and display space and the common components and techniques with which to work, it would have been obvious to a person of ordinary skill in the art at the time of the alleged invention to try to combine any of the charted prior art references with one or more of the other charted prior art references.

6. **Combining any charted prior art reference with one or more of the other charted prior art references would have yielded no unexpected results.** The combination of the teachings of any charted prior art reference with one or more of the other charted prior art references would not have yielded any unexpected result or resulted in any inoperable combination because it would simply be implementing minor, straightforward, and/or well-known variations in scanner and display design to achieve slight variations in the operation of the device.
7. **A person of ordinary skill in the art at the time of the alleged invention would have had a reasonable expectation of success in combining any charted prior art reference with one or more of the other charted prior art references.** All the above reasons—for example, the predictability of the combination, the lack of unexpected results, and the similarity in the disclosures of the charted prior art references—would have led a person of ordinary skill in the art at the time of the alleged invention to have a reasonable expectation of success in combining the teachings of any one or more of these references, and it would have been well within the technical capability of such a person to combine them without undue experimentation.

2. Specific Motivations to Combine

As described above, each of the independent claims of the '221 patent is generally directed to (a) a handheld device for optically scanning a 3D environment, (b) at least one display remotely connected to the handheld device that is adapted for visually representing the physical 3D environment, (c) the handheld device featuring a 3D user interface for remotely controlling the display, and (d) the handheld device featuring a motion sensor for remotely controlling the display view. A person of ordinary skill would have been motivated to add these features as one of a limited number of design options available when implementing a scanner and display.

The dependent claims add trivial variations to these elements, including (i) disclosing that the one motion sensor is “an accelerometer, gyro, or magnetometer,” (ii) the motion sensor being capable of detecting “gestures” and the capability of using either the actuators on the handheld device or the detected “gestures” to manipulate the display, and (iii) arranging the display on a cart. A person of ordinary skill would have been motivated to add each of these features to any of the charted references as part of a limited number of design options that confer known benefits while yielding predictable results.

Exemplary motivations to combine each of these features with any of the charted references are described below.

A Handheld Optical Scanning Device

All independent claims of the '221 patent require a “handheld device” for optically scanning a 3D environment. There is nothing inventive, however, about a handheld device that is capable of scanning an environment as claimed by the '221 patent. Optical scanners were well-known in the art and part of the general knowledge of a person of ordinary skill. In fact, the '221 patent explicitly acknowledges that “[t]he Lava C.O.S. scanner marketed by 3M ESPE,” which is an optical intraoral scanner, was known in the art before the time of the invention. *Id.*, 8:43-51.

As yet another example, U.S. Patent Publication No. 2008/0071143 (“Gattani”) which published on Mar. 20, 2008, discloses “an endoscopic surgical navigation system” for scanning a human body. Gattani’s system uses position sensors such as electromagnetic sensors or optical sensors on the distal tip of a scope inserted inside a patient to capture position. Gattani at ¶¶0047, 0058, 0064, 0073, 0088, 0094, 0099-111. The position and orientation of the scanner can also be tracked. *Id.* at ¶¶0105-0111.

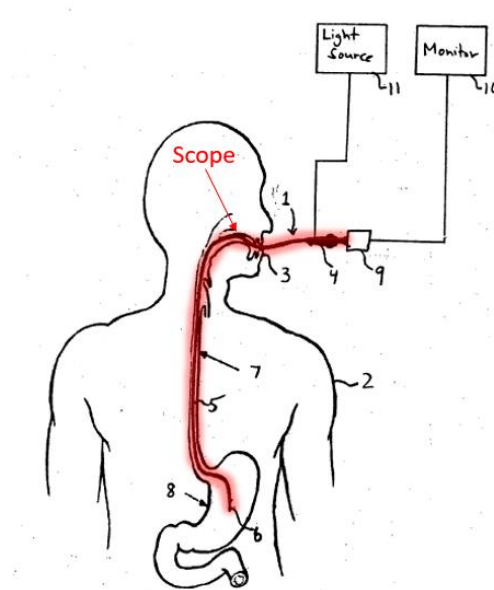


FIG. 1

Gattani, Fig. 1

As another example, U.S. Patent Publication No. 2007/0171220 (“Kriveshko”), which was published on Jul. 26, 2007, discloses a system 100 including scanning device 102 with input device 116:

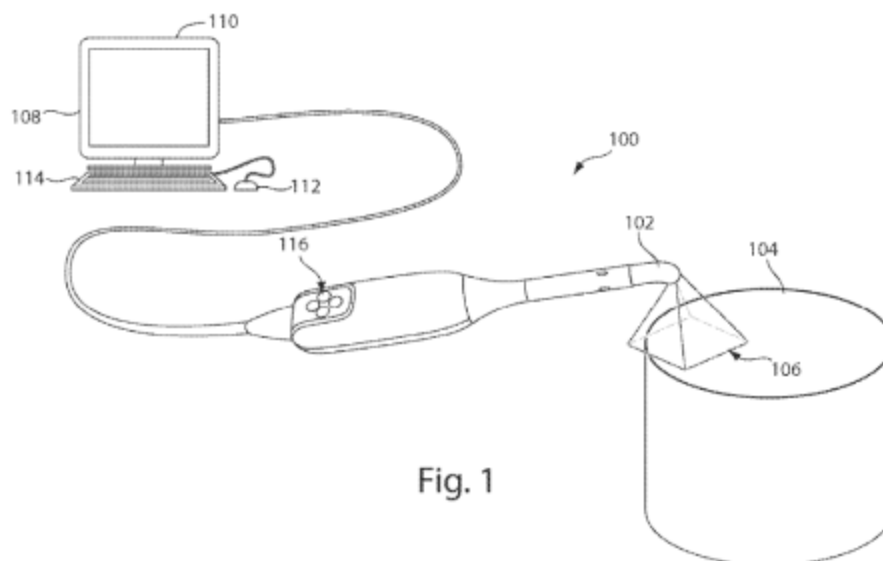


Fig. 1

Kriveshko, Fig. 1

Kriveshko discloses “scanner 102 is a handheld, freely positionable probe having at least one user input device, such as a button, lever, dial, thumb wheel, switch, or the like, for user control of the image capture system 100 such as starting and stopping scans.” *Id.*, ¶0052 (emphasis added). The scanning device 102 acquires three-dimensional data. *Id.* Kriveshko’s scanning system 100 includes computer 108 having display 110. *Id.*, ¶0051.

As another example, U.S. Patent Publication No. 2006/002024 (“Serra”), which published on Jan. 26, 2006, teaches a system for capturing and maintaining images comprising a handheld probe capable of capturing a substantially real-time 3D images of a 3D space and a computer, including a display for displaying the captured 3D images.

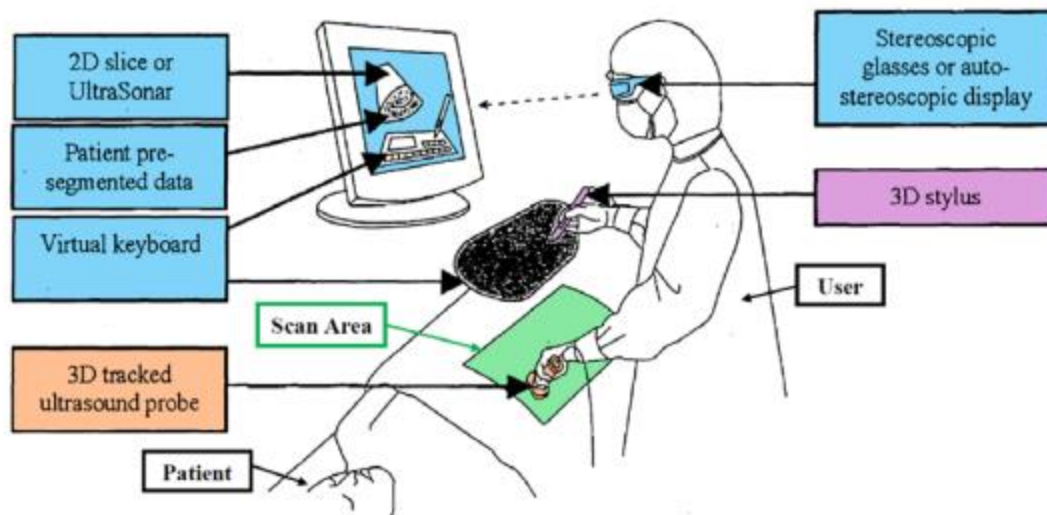


FIG. 10

Serra, Fig. 10 (annotated)

It would have been obvious to enhance the type of scanned 3D data of Serra's scanner with an optical scanner. Indeed, Serra contemplates "exploit[ing] the informational benefits of each probe type," and a person of ordinary skill would have recognized and pursued the benefits of modifying the scanning system of Serra into an optical scanner for different informational benefits (e.g., optical data). Serra, [0050]. It would have also been obvious in light of the general knowledge of a person of ordinary skill to modify Serra's handheld scanner into an optical scanner with a reasonable expectation of success because the principles of operation were well understood and operated in a predictable manner such that it would have been straight-forward to modify Serra's handheld scanner into an optical scanner, using routine steps to produce a scanner capable of optical detection of an object.

As another example, Bajura discloses an ultrasound scanning system for scanning a 3D environment. *See Bajura*, p. 203. The scanning system uses an ultrasound scanner to acquire an echography image which tracks the scanner’s “position and orientation in 3D world space.” *Id.*, p. 205. The scanning system then uses an image-generation system to generate 3D renderings of the scanned 2D ultrasound images. *Id.* These images are then video mixed with real-world images and displayed as a composite image which registers the 2D ultrasound data in its true 3D location. *Id.*

Thus, a person of ordinary skill would have been motivated to add a handheld optical scanning device into a scanning system because it was well-known in the industry the benefits that such a handheld device could provide.

A Remotely Connected Display Adapted for Visually Representing the Physical 3D Environment

All independent claims of the ’221 patent require a display that is remotely connected to the handheld optical scanning device that is adapted for visually representing the physical 3D environment.

As discussed above, the Board in its Final Written Decision in IPR2018-00197 found Kriveshko discloses “scanner 102 is a handheld, freely positionable probe having at least one user input device, such as a button, lever, dial, thumb wheel, switch, or the like, for user control of the image capture system 100 such as starting and stopping scans.” *Id.*, [0052] (emphasis added). The scanning device 102

acquires three-dimensional data. *Id.* Kriveshko's scanning system 100 includes computer 108 having display 110. *Id.*, [0051]. Notably, the Board found in view of Fig. 4, that the display 110 of Kriveshko visually represents a physical 3D environment.

Similarly, Gattani discloses a system which uses the position/orientation information to determine the view on a display: "At 502 the VNS 30 determines the current position and orientation of the scope's distal tip. At 503 the VNS 30 generates real-time 3-D (volumetric) scan images, based on the intra-operative scan data and the current position and orientation of the scope's distal tip. The VNS 30 then co-registers the real-time 3-D scan images with the live video from the endoscopic video camera at 504. The co-registered scan images and live video are then sent to a monitor (which may be integral with or external to the VNS 30) for display. . . ." *Id.* at [0064].

As another example, Bajura discloses a remotely connected display adapted for visually representing the 3D environment. *See Bajura*, p. 203. The scanning system of Bajura is capable of visualizing the scanned results using a "small video camera mounted in front of a conventional head-mounted display worn by an observer. *Id.* The head-mounted display (HMD) is capable of displaying "live" ultrasound echography data visualized within a pregnant human subject. *Id.* The scanning system then uses an image-generation system to generate 3D renderings of

the scanned 2D ultrasound images. *Id.* These images are then video mixed with real-world images and displayed as a composite image which registers the 2D ultrasound data in its true 3D location. *Id.*

Thus, a person of ordinary skill would have been motivated to add a remotely connected display adapted for visually representing the scanned 3D environment into a scanning system because it was well-known in the industry the benefits that such a display could provide.

The Handheld Device Featuring a 3D User Interface for Remotely Controlling the Display

All independent claims of the '221 patent require the handheld optical scanning device featuring a 3D user interface for remotely controlling the display.

It would have been obvious to the person of ordinary skill in the art to combine Kriveshko with any of the references listed in Table 1 and/or the System Prior Art. Kriveshko discloses a robust suite of image/view manipulation functions such as “rotating, scaling, panning, and the like” that can be initiated by a user using a “user input device.” Kriveshko, [0090-91]. It would have been obvious to combine Kriveshko with any of the listed references because Kriveshko teaches “techniques for resuming a three-dimensional scan after losing data acquisition” and generally relates to devices and apparatuses for “continuous scanning in which incremental three-dimensional data is acquired and assembled into a full three-dimensional model.” Kriveshko, [0002]-[0004]. Kriveshko explains that “[t]here remains a need

for processing techniques that identify and aid in recovery from errors in incremental scans. There also remains a need for real time feedback systems to support recovery from a lost scanning sequence while the scan is in progress.” Kriveshko, [0017]. The motivation to combine is provided by Kriveshko, which is so that “a full three-dimensional surface scan may be obtained for two dental arches in occlusion.” Kriveshko, [0008].

Similarly, it would also have been obvious to the person of ordinary skill in the art to combine Serra with any of the references listed in Table 1 and/or the System Prior Art. Serra discloses a handheld device that includes a 3D user interface for remotely controlling the display to adjust the view with which the 3D environment is represented on the display. In particular, Serra discloses a handheld 3D scanning device that can control display parameters to interactively manipulate 3D data in an interactive visualization mode. Serra, [0053-0054]. Relevant to these limitations in particular, Serra discloses that “the user can release the button on the probe, and *use the tracking information in the ultrasound probe to rotate the entire scene (effectively changing the viewpoint of the user over the entire 3D scene).*” *Id.*, [0054], [0074] (describing the sensor that obtains the tracking information) (emphasis added). Serra further discloses “the **3D position** of the ultrasound probe 715 can be tracked by 3D tracker 703, by, for example, **3D sensor** 720 which is attached to ultrasound probe 715.” *Id.*, [0074] (emphasis added). Thus, Serra teaches

a single device with two alternative modes of scanning and 3D data set interactive visualization actuated by one or more buttons. Serra also teaches ergonomic advantages from permitting a scanning process and an examination process with the same device because a user is always holding the device. *Id.*, [0053].

As another example, Bajura discloses the handheld device featuring a 3D user interface. *See Bajura*, p. 203. The scanning system of Bajura visualizes the scanning results by using a small video camera mounted in front of a conventional head-mounted display worn by an observer. *Id.*, 206. The camera's video images are composite with computer-generated ones that contain one or more 2D ultrasound images properly transformed to the observer's current viewing position. *Id.* As the observer walks around the subject, the ultrasound images appear stationary in 3-space within the subject. *Id.*

Thus, a person of ordinary skill would have been motivated to add 3D interface into a scanning system because it was well-known in the industry the benefits that such an interface could provide.

The Handheld Device Featuring a Motion Sensor for Remotely Controlling the Display View

All independent claims of the '221 patent require the handheld optical scanning device featuring a motion sensor for remotely controlling the display view. As discussed below in Section V.D.2 for the '667 patent, there is nothing inventive about the use of motion sensors to control the display, as claimed by the '221 patent.

Motion sensors were first developed in the 1940s during World War II.¹ Since then, motion sensors have been used in a variety of fields (e.g., gaming² and medical³). By 2008, intraoral scanners incorporated motion sensors to improve scanning accuracy when rotating the device during a scan.⁴ The '221 patent merely explains that the motion sensors can improve user interface functionality by detecting gestures which can be used to control the display or orient the display on the screen of the 3D teeth models. *See* '221 patent at 4:43-50. By the time of the alleged invention of the '221 patent, prior art was replete with utilizing motion sensors in intraoral scanners.

For example, U.S. Patent Pub. No. 2005/0237581 ("Knighton"), discloses that the scanning device could include a position tracking device, which could be an accelerometer, that generates movement output data indicating movement of the device. *See* Knighton at [0044] ("Position tracking or detection sensor 321 may be a single device or combination of devices. The devices may include a gyroscope, global position device, altimeter or similar device that detects the orientation and

¹ *See* Coulombe, <https://www.securityinfowatch.com/alarms-monitoring/alarm-systems-intrusion-detection/article/21219314/tech-trends-the-next-evolution-of-motion-detection>

² U.S. Patent No. 7,774,155 at Abstract.

³ U.S. Patent No. 6,721,386.

⁴ S Logozzo, G Franceschini, A Kilpelä, M Caponi, L Governi, L Blois. A Comparative Analysis Of Intraoral 3d Digital Scanners For Restorative Dentistry. *The Internet Journal of Medical Technology*. 2008 Volume 5 Number 1 at 8-9 (discussing the Lava C.O.S., and the 3D-in-Motion technology).

position of the device in three-dimensional space. In one embodiment, a set of gyroscopes and accelerometers may be used for each of an x, y and z axis. The position detection or tracking device may generate positions or movement output data that indicate the position or movement of the device that may be used by software executing on processor 301 or a remote computing device to generate the three dimensional representation of a target.”).

As another example, Serra discloses a “3D sensor” that directly detects motion. Serra teaches rotating the 3D data presented on the display using tracking information corresponding to the movement of the scanning device. Serra, [0054]. Indeed, the Board previously found that Serra satisfied claims 4, 5, 8, and 19 of the ’675 patent (the predecessor of the ’221 patent), requiring a “motion sensor,” because “Serra’s ‘3D sensor’ senses motion through tracking position and orientation.” *See Align Technology Inc. v. 3Shape A/S*, IPR2018-00197, Final Written Decision, Paper No. 22, at p. 54-55 (May 29, 2019). A person of ordinary skill would have understood that Serra’s 3D sensor is a motion sensor given that Serra’s 3D sensor is used to determine the three-dimensional movement of the scanning device.

As yet another example, U.S. Patent Publ. No. 2005/0212756 (“Marvit”), which was published on September 29, 2005, teaches to build “a motion detection module operable to detect motion of the device within three dimensions and to

identify components of the motion in relation to the viewable surface,” and that such a device can also “include[] a gesture database comprising a plurality of gestures, each gesture defined by a motion of the device with respect to a first position of the device.” Marvit, Abstract. Marvit explains that “Technical advantages of particular embodiments include the ability to navigate through a virtual desktop using a plurality of motion interface gestures. This allows menus of information to be flattened since a user may easily navigate across a particular menu too large to fit on a device's display. Accordingly, a user may need to memorize less menu information thus increasing functionality and capability of the device for the user. Other technical advantages will be readily apparent to one skilled in the art from the following figures, descriptions and claims.” Marvit, [0006]-[0007].

As yet another example, Bajura discloses the handheld device featuring a motion sensor for remotely controlling the view. Bajura, p. 205. Bajura discloses that the position and orientation of its ultrasound scanner as well as its head mounted display is tracked with 6 degrees of freedom (DOF). *Id.* Using the geometry of the ultrasound scanner as well as its head mounted display, Bajura discloses that its image-generation system then generates 3D renderings of the 2D ultrasound images, which are then video mixed with real-world images from a miniature TV camera mounted on the HMD. *Id.* Thus, the resulting composite images show the 2D ultrasound data registered in its true 3D location. *Id.*

Thus, a person of ordinary skill would have been motivated to add a motion sensor for remotely controlling the display view into a scanning system because it was well-known in the industry the benefits that motion sensors could provide. In addition to the motivations to combine provided below, the motivations to combine any of the below references provided in IPR2018-00197, IPR2018-00198, IPR2022-00144, and/or IPR2022-00145 are hereby incorporated by reference and provide motivation to combine any such reference with any of the references in Table 1.

3. Secondary Considerations

Defendants are not aware of objective evidence or secondary considerations demonstrating non-obviousness of the asserted claims of the '221 patent. As set forth below, the evidence confirms that the asserted claims would have been obvious to a person of ordinary skill in the art at the time of the alleged invention. Defendants reserve the right to supplement or modify these factors to address any evidence or arguments later identified by 3Shape.

(a) The Alleged Invention Did Not Satisfy a Long-Felt But Unresolved Need

Defendants are not aware of any evidence of a long-felt but unmet need that the asserted claims solve. On the contrary, the concepts and functions described in the asserted claims of the '221 patent were all well-known before the alleged invention date as evidenced by the patent itself, its file history and the references

cited therein, and the prior art Defendants have identified in these contentions and accompanying exhibits.

(b) The Alleged Invention Did Not Face Skepticism or Teaching Away by Experts

Defendants are not aware of any evidence of a failure of others to invent or use the claimed techniques before the alleged invention dates of the '221 patent. As discussed, the '221 patent recites concepts that were already known in the prior art.

(c) The Alleged Invention Was Not Subject to Industry Acceptance

Defendants are not aware of any evidence that 3Shape's alleged invention in the '221 patent was subject to additional industry acceptance due to 3Shape or the '221 patent. This is at least because the subject matter of the '221 patent already existed in the industry and was used by many entities and individuals prior to the '221 patent.

(d) The Alleged Invention Has Not Been Subject to Industry Praise

Defendants are not aware of any evidence of industry praise for any of the alleged inventions of the '221 patent. To the extent any industry praise is related to any functionality that 3Shape alleges practices the '221 patent, that praise is not due to the allegedly novel features of the '221 patent, but instead only to features present in the prior art, which is not a sufficient nexus for purposes of obviousness. See *Muniauction, Inc. v. Thomson Corp.*, 532 F.3d 1318, 1328 (Fed. Cir. 2008).

(e) The Alleged Invention Is Not Responsible for Commercial Success

Defendants are not aware of any evidence of alleged success of any products that is due to the alleged invention claimed in the '221 patent. The patentee bears the burden of demonstrating that the relevant commercial success is attributable to the claimed invention “as opposed to other economic and commercial factors unrelated to the technical quality of the patented subject matter.” *Cable Elec. Prods, Inc. v. Genmark, Inc.*, 770 F. 2d 1015, 1027 (Fed. Cir. 1987). Here, 3Shape has not shown (and cannot show) that any commercial success is due to the alleged invention of the '667 patent. *See Windsurfing Int’l Inc. v. AMF*, 782 F. 2d 995 (Fed. Cir. 1986) (considerations such as intervening, non-covered technological innovations, popularity of accessories, and advertising expense are all relevant to the nexus determination).

Moreover, to the extent any commercial success of any products is due to concepts discussed in the '221 patent, those concepts were already present in the prior art, as described above, and thus does not support any commercial success that is relevant to the question of obviousness. *Tokai Corp. v. Easton Enterprises, Inc.*, 632 F.3d 1358, 1369-70 (Fed. Cir. 2011) (“If commercial success is due to an element in the prior art, no nexus exists.”); *In re Huai-Hung Kao*, 639 F.3d 1057, 1068 (Fed. Cir. 2011) (“Where the offered secondary consideration actually results from something other than what is both claimed and novel in the claim, there is no

nexus to the merits of the claimed invention.”); *Ormco Corp. v. Align Tech., Inc.*, 463 F.3d 1299, 1312 (Fed. Cir. 2006) (“[I]f the feature that creates the commercial success was known in the prior art, the success is not pertinent.”).

(f) There Is No Evidence to Show Copying of the Alleged Invention

Defendants are not aware of any evidence of any aspect of the ’221 patent that was copied by any entity or person, much less that any functionality that practices the ’221 patent was copied. *See Amazon.com, Inc. v. Barnesandnoble.com, Inc.*, 239 F.3d 1343, 1366 (Fed. Cir. 2001) (allegedly copied feature must be an embodiment of the patented claims).

(g) Simultaneous Development of the Alleged Invention Confirms that the Asserted Claims Were Obvious

As set forth above, many people and companies independently and simultaneously developed and invented the same technology within a comparatively short space of time of a few years, which further shows that the ’221 patent was the product only of ordinary engineering skill. Moreover, the fact that there was relatively simultaneous invention demonstrates that the subject matter of the ’221 patent was already well within the level of ordinary skill in the art.

B. The ’151 Patent

1. Combinations

The charts identified above in **Error! Reference source not found.** and the chart included in Exhibit 151-B (collectively, ’151 Patent Claim Charts) set forth the

bases for obviousness, identifying the disclosures of each reference that can be combined on a limitation-by-limitation basis with disclosures from other references (including the ones identified in **Error! Reference source not found.** and in Exhibit 151-B). Each of the '151 Patent Claim Charts demonstrates that the charted references render obvious, based on its disclosure alone or in combination with the knowledge of person of skill in the art or with other charted reference(s), each asserted claim of the '151 patent. Exhibit 151-B identifies numerous disclosures in additional prior art references, any of which would be obvious to combine with one or more of the prior art references charted in the '151 Patent Claim Charts in a predictable way with a reasonable expectation of success to render obvious the claimed invention at issue, to the extent such primary reference is missing the disclosed limitation.

Specifically, if Plaintiff argues that any particular prior art reference lacks any claimed feature, a person of ordinary skill in the art as of the '151 patent's purported invention date would have been motivated to modify the reference to include the allegedly missing claimed feature, or to combine it with other references that include that claimed feature, as disclosed in the aforementioned exhibits. As further discussed in Section V.B.2 below, additional exemplary motivations to combine applicable to each limitation for each of the charted references include the following:

- 1. The charted prior art references are in the same field of endeavor as the '151 patent.** The charted prior art references and the '151 patent

generally relate to measuring and comparing tooth characteristics for the purpose of designing and manufacturing dental restorations.

2. **The charted prior art references are aimed at solving the same perceived problem as the '151 patent.** The charted prior art references and the '151 patent are generally aimed at enhancing dental restoration manufacturing techniques, by improving the efficiency and accuracy of existing practices. '151 patent at 1:61-2:2.
3. **The charted prior art references use similar techniques to solve the same problems.** The charted prior art references generally teach one or more of the same techniques, namely (a) collecting texture, shape, and/or color data of a tooth, (b) creating a digital 3D representation of that tooth, and (c) analyzing the collected data to obtain a matching tooth shade value based on a set of reference shades. One of ordinary skill, with knowledge of each of these references, would understand that any feature or function set forth in one of these references could be exchanged or added to the teachings of another with a reasonable expectation of such (and minimal or no hardware changes).
4. **Combining any charted prior art reference with one or more of the other charted prior art references would have been a predictable combination.** It would have been entirely predictable to a person of ordinary skill in the art at the time of the alleged invention to combine any of the charted prior art references with one or more of the other charted prior art references. As mentioned, all of these references are aimed toward designing and manufacturing dental restorations. Given the finite number of identified, predictable solutions in the designing and manufacturing dental restorations space and the common components and techniques with which to work, it would have been obvious to a person of ordinary skill in the art at the time of the alleged invention to try to combine any of the charted prior art references with one or more of the other charted prior art references.
5. **Combining any charted prior art reference with one or more of the other charted prior art references would have yielded no unexpected results.** The combination of the teachings of any charted prior art reference with one or more of the other charted prior art references would not have yielded any unexpected result or resulted in any inoperable combination because it would simply be implementing minor, straightforward, and/or well-known variations in diagnostic

imaging device design to achieve slight variations in the operation of the device.

6. **A person of ordinary skill in the art at the time of the alleged invention would have had a reasonable expectation of success in combining any charted prior art reference with one or more of the other charted prior art references.** All the above reasons—for example, the predictability of the combination, the lack of unexpected results, and the similarity in the disclosures of the charted prior art references—would have led a person of ordinary skill in the art at the time of the alleged invention to have a reasonable expectation of success in combining the teachings of any one or more of these references, and it would have been well within the technical capability of such a person to combine them without undue experimentation.

2. Specific Motivations to Combine

As described above, each of the independent claims of the '151 patent is generally directed to (a) obtaining a digital 3D representation of the tooth, where the digital 3D representation comprises shape data and texture data for the tooth; and (b) determining a tooth shade value for at least one point on the tooth based on the texture data of the corresponding point of the digital 3D representation and on known texture values of one or more reference tooth shade values. The independent claims also contain other limitations including (c) deriving a certainty score for the shade match, (d) creating a tooth shade profile of collected data from various points on the tooth, and (e) recording a series of sub-scans of the tooth in order to create the digital 3D representation. These features are inherent or obvious parts of methods for determining the shade of a patient's tooth, and a POSITA would have been

motivated to implement them as one of a limited number of options available when developing methods of designing and manufacturing dental restorations.

The dependent claims add trivial variations to the claimed method, including “wherein determining the tooth shade value for the point comprises selecting the reference tooth shade value with the known texture value closest to the texture data of the point,” “wherein determining the tooth shade value for the point comprises an interpolation of the two or more reference tooth shade values having known texture values close to the texture data of the point,” “wherein the method comprises comparing the derived certainty score with a range of acceptable certainty score values,” “wherein the certainty measure relates to how uniform the sub-scan texture information is at the point,” “wherein the one or more reference tooth shade values relate to shade values for natural teeth with intact surface and/or to shade values for teeth prepared for a dental restoration,” “wherein the method comprises comparing the texture data with known texture values for soft oral tissue, such as gum tissue and gingiva,” and “wherein the texture information comprises at least one of tooth color or surface roughness.” A person of ordinary skill would have been motivated to add each of these features to any of the charted references as part of a limited number of design options that confer known benefits while yielding predictable results.

Exemplary motivations to combine each of these features with any of the charted references are described below.

Digital 3D Representation

All independent claims of the '151 patent describe “obtaining a digital 3D representation of the tooth” that comprises shape data and texture data for the tooth. There is nothing inventive, however, about obtaining a digital 3D representation of a tooth as claimed by the '151 patent. By the time of the alleged invention of the '151 patent, prior art was replete with different techniques for obtaining a digital 3D representation of a tooth.

Long before its implementation into intraoral scanners, the first 3D scanning technology was created in the 1960s.⁵ Once the technology developed to become more reliable and economically practical, it was quickly implemented into multiple industries, such as in construction, design, and engineering.⁶ Medical and dental industries were no exception – the concept of computer-aided design/computer-aided manufacturing (CAD/CAM) was first introduced in dental applications in 1973.⁷ By 2014, many 3D intraoral scanners had entered the market, and the

⁵ See Milan Edl, *3D Laser Scanners: History and Applications*, Acta Simulatio – International Scientific Journal about Simulation, Vol. 4, No. 4 (Feb. 2001).

⁶ *Id.*

⁷ See Henry Hann-Min Hwang, *An Overview of Digital Intraoral Scanners: Past, Present and Future – From an Orthodontic Perspective*, Vol. 30 No. 3 (2018).

technology was commonplace.⁸ The move toward creating digital models in the industry was motivated by the improved time-efficiency and comparable accuracy to methods involving conventional impression techniques.⁹

This was evident to the patent examiner of the '151 patent – on September 20, 2020, the examiner rejected independent claim 1 on the basis that prior art disclosed obtaining a digital 3D representation of the tooth where the digital 3D representation comprises shape data and texture data for the tooth.¹⁰ Defendants also provide a multitude of charted references that demonstrate existing technology able to obtain a digital 3D representation of a tooth.¹¹ For example, Lehmann discloses creating “a digital impression which is a three dimensional model of a treatment area.”¹² Further, Babayoff discloses using “a three-dimensional surface scanner with color capabilities.”¹³

Accordingly, a person of ordinary skill would have been motivated to add a digital 3D representation to any charted reference that did not already disclose it to achieve the benefits of improved time-efficiency and accuracy. Digital 3D representations would be particularly desirable for evaluating a tooth shade match,

⁸ *Id.*

⁹ *Id.*; see also U.S. Patent No. 10,069,151 at 1:61-2:2.

¹⁰ See '151 Patent Prosecution History, Sep. 20, 2020 Office Action.

¹¹ Exhibit 151, Exhibit 151-B

¹² Lehmann (U.S. Patent Pub. App. No. 2007/0026363) at [0005]

¹³ Babayoff (U.S. Patent No. 7,698,068) at 8:13-22

which is often required in the design and manufacture of crowns or bridge restorations. In these situations, a patient will benefit from receiving the dental restoration as quickly as possible, so as to minimize the downtime in which they do not have full use of their teeth. To the extent that any charted reference describes obtaining a digital 3D representation of a tooth in a different context, it would have been obvious to apply it to methods of tooth shade matching due to the shared needs of various dental applications.

These motivations to combine are exemplary, and Defendants reserve the right to supplement these contentions as its understanding of the scope and content of prior art develops.

Determining Tooth Shade Based on Reference Tooth Shade

The independent claims of the '151 patent recite “determining a tooth shade value for at least one point on the tooth based on the texture data of the corresponding point of the digital 3D representation and on known texture values of one or more reference tooth shade values.” In essence, this describes finding a tooth shade by comparing to reference tooth shades – a concept that not only was well-known at the time of the priority date of the '151 patent, but was obvious to anyone with common sense, let alone a person having skill in the art. Thus, a person of ordinary skill would have been motivated to incorporate determining a tooth shade value based on

reference tooth shade values into existing methods of designing and manufacturing dental restorations.

The prior art was replete with methods using reference tooth shades to determine a tooth shade value. In fact, the '151 patent itself references commonly used tooth shade guides for commercially available ceramics, such as the VITA 3D-Master or the VITA Classic shade guides provided by VITA Zahnfabrik, Germany.¹⁴ These same shade guides are referenced in several prior art references charted by Defendants, including Lehmann (“the VITA™ Shade guide is often discussed herein”), Babayoff (“a shade guide, such as for example VITA”), Chu (“the corresponding Vitapan 3D-Master shade”), and Inglese (“the ‘Vita Lumin Classic’ dental shade guide”).¹⁵ Other references, like Kerschbaumer, make reference to commercially available shade guides without naming specific ones.¹⁶ Thus, not only would it have been obvious for a person having skill to implement reference tooth shades into any existing dental restoration methods, it would have been obvious to implement this specific tooth shade guide. Doing so would have been easily achievable with predictable results.

14 U.S. Patent No. 10,069,151 at 1:48-50.

15 See Lehmann at [0162], Babayoff at 2:24-43, and Chu at e8; see also Exhibit 151, Exhibit 151-B

16 See Kerschbaumer at 1:16-41.

Further, other prior art discloses matching tooth shades based on reference tooth shades other than commercial tooth shade guides. Kerschbaumer, for example, discloses “an advance relative to the use of a conventional shade guide,” involving shade determination using reference coloration from existing adjacent teeth.¹⁷ A person having skill would therefore have also found it obvious to implement determining tooth shades based on reference tooth shades other than commercial guides.

3. Secondary Considerations

Defendants are not aware of objective evidence or secondary considerations demonstrating non-obviousness of the asserted claims of the '151 patent. As set forth below, the evidence confirms that the asserted claims would have been obvious to a person of ordinary skill in the art at the time of the alleged invention. Defendants reserve the right to supplement or modify these factors to address any evidence or arguments later identified by 3Shape.

(a) The Alleged Invention Did Not Satisfy a Long-Felt But Unresolved Need

Defendants are not aware of any evidence of a long-felt but unmet need that the asserted claims solve. On the contrary, the concepts and functions described in the asserted claims of the '151 patent were all well-known before the alleged

¹⁷ *Id.* at 1:22-24, 2:13-16.

invention date as evidenced by the patent itself, its file history and the references cited therein, and the prior art Defendants have identified in these contentions and accompanying exhibits.

(b) The Alleged Invention Did Not Face Skepticism or Teaching Away by Experts

Defendants are not aware of any evidence of a failure of others to invent or use the claimed techniques before the alleged invention dates of the '151 patent. As discussed, the '151 patent recites concepts that were already known in the prior art.

(c) The Alleged Invention Was Not Subject to Industry Acceptance

Defendants are not aware of any evidence that 3Shape's alleged invention in the '151 patent was subject to additional industry acceptance due to 3Shape or the '151 patent. This is at least because the subject matter of the '151 patent already existed in the industry and was used by many entities and individuals prior to the '151 patent.

(d) The Alleged Invention Has Not Been Subject to Industry Praise

Defendants are not aware of any evidence of industry praise for any of the alleged inventions of the '151 patent. To the extent any industry praise is related to any functionality that 3Shape alleges practices the '151 patent, that praise is not due to the allegedly novel features of the '151 patent, but instead only to features present

in the prior art, which is not a sufficient nexus for purposes of obviousness. See *Muniauction, Inc. v. Thomson Corp.*, 532 F.3d 1318, 1328 (Fed. Cir. 2008).

(e) The Alleged Invention Is Not Responsible for Commercial Success

Defendants are not aware of any evidence of alleged success of any products that is due to the alleged invention claimed in the '151 patent. The patentee bears the burden of demonstrating that the relevant commercial success is attributable to the claimed invention “as opposed to other economic and commercial factors unrelated to the technical quality of the patented subject matter.” *Cable Elec. Prods, Inc. v. Genmark, Inc.*, 770 F. 2d 1015, 1027 (Fed. Cir. 1987). Here, 3Shape has not shown (and cannot show) that any commercial success is due to the alleged invention of the '151 patent. See *Windsurfing Int’l Inc. v. AMF*, 782 F. 2d 995 (Fed. Cir. 1986) (considerations such as intervening, non-covered technological innovations, popularity of accessories, and advertising expense are all relevant to the nexus determination).

Moreover, to the extent any commercial success of any products is due to concepts discussed in the '151 patent, those concepts were already present in the prior art, as described above, and thus does not support any commercial success that is relevant to the question of obviousness. *Tokai Corp. v. Easton Enterprises, Inc.*, 632 F.3d 1358, 1369-70 (Fed. Cir. 2011) (“If commercial success is due to an element in the prior art, no nexus exists.”); *In re Huai-Hung Kao*, 639 F.3d 1057,

1068 (Fed. Cir. 2011) (“Where the offered secondary consideration actually results from something other than what is both claimed and novel in the claim, there is no nexus to the merits of the claimed invention.”); *Ormco Corp. v. Align Tech., Inc.*, 463 F.3d 1299, 1312 (Fed. Cir. 2006) (“[I]f the feature that creates the commercial success was known in the prior art, the success is not pertinent.”).

(f) There Is No Evidence to Show Copying of the Alleged Invention

Defendants are not aware of any evidence of any aspect of the ’151 patent that was copied by any entity or person, much less that any functionality that practices the ’151 patent was copied. *See Amazon.com, Inc. v. Barnesandnoble.com, Inc.*, 239 F.3d 1343, 1366 (Fed. Cir. 2001) (allegedly copied feature must be an embodiment of the patented claims).

(g) Simultaneous Development of the Alleged Invention Confirms that the Asserted Claims Were Obvious

As set forth above, many people and companies independently and simultaneously developed and invented the same technology within a comparatively short space of time of a few years, which further shows that the ’151 patent was the product only of ordinary engineering skill. Moreover, the fact that there was relatively simultaneous invention demonstrates that the subject matter of the ’151 patent was already well within the level of ordinary skill in the art.

C. The ’146 Patent

1. Combinations

The charts identified above in Table 7 and the chart included in Exhibit 146-B (collectively, '146 Patent Claim Charts) set forth the bases for obviousness, identifying the disclosures of each reference that can be combined on a limitation-by-limitation basis with disclosures from other references (including the ones identified in Table 7 and in Exhibit 146-B). Each of the '146 Patent Claim Charts demonstrates that the charted references render obvious, based on its disclosure alone or in combination with the knowledge of person of skill in the art or with other charted reference(s), each asserted claim of the '146 patent. Exhibit 146-B identifies numerous disclosures in additional prior art references, any of which would be obvious to combine with one or more of the prior art references charted in the '146 Patent Claim Charts in a predictable way with a reasonable expectation of success to render obvious the claimed invention at issue, to the extent such primary reference is missing the disclosed limitation.

Specifically, if Plaintiff argues that any particular prior art reference lacks any claimed feature, a person of ordinary skill in the art as of the '146 patent's purported invention date would have been motivated to modify the reference to include the allegedly missing claimed feature, or to combine it with other references that include that claimed feature, as disclosed in the aforementioned exhibits. As further discussed in Section V.C.2 below, additional exemplary motivations to combine applicable to each limitation for each of the charted references include the following:

1. **The charted prior art references are in the same field of endeavor as the '146 patent.** The charted prior art references and the '146 patent generally relate to diagnostic imaging techniques and/or intraoral scanner design, at most addressing one or more distinct functional areas within a broader diagnostic imaging and/or intraoral scanner device design.
2. **The charted prior art references are aimed at solving the same perceived problem as the '146 patent.** The charted prior art references and the '146 patent are generally aimed at enhancing diagnostic imaging techniques and/or intraoral scanner device design, including overcoming problems such as “discriminating out-of-focus information” and providing “a fast scan time.” ‘146 at 2:40-42.
3. **The charted prior art references use similar techniques to solve the same problems.** The charted prior art references generally teach one or more of the same techniques, namely (a) transmitting a probe light towards an object in an oral cavity and thereby illuminating part of the object with a time-varying illumination pattern, (b) forming, by a camera, a plurality of 2D images based on light returned from the object, and (c) determining a 3D geometry on the object based on the 2D images and the time-varying illumination pattern. One of ordinary skill, with knowledge of each of these references, would understand that any feature or function set forth in one of these references could be exchanged or added to the teachings of another with a reasonable expectation of such (and minimal or no hardware changes).
4. **Combining any charted prior art reference with one or more of the other charted prior art references would have been a predictable combination.** It would have been entirely predictable to a person of ordinary skill in the art at the time of the alleged invention to combine any of the charted prior art references with one or more of the other charted prior art references. As mentioned, all of these references are in the diagnostic imaging and/or intraoral scanner space and disclose similar designs. Given the finite number of identified, predictable solutions in the diagnostic imaging or intraoral scanner space and the common components and techniques with which to work, it would have been obvious to a person of ordinary skill in the art at the time of the alleged invention to try to combine any of the charted prior art references with one or more of the other charted prior art references.

5. **Combining any charted prior art reference with one or more of the other charted prior art references would have yielded no unexpected results.** The combination of the teachings of any charted prior art reference with one or more of the other charted prior art references would not have yielded any unexpected result or resulted in any inoperable combination because it would simply be implementing minor, straightforward, and/or well-known variations in diagnostic imaging device design to achieve slight variations in the operation of the device.
6. **A person of ordinary skill in the art at the time of the alleged invention would have had a reasonable expectation of success in combining any charted prior art reference with one or more of the other charted prior art references.** All the above reasons—for example, the predictability of the combination, the lack of unexpected results, and the similarity in the disclosures of the charted prior art references—would have led a person of ordinary skill in the art at the time of the alleged invention to have a reasonable expectation of success in combining the teachings of any one or more of these references, and it would have been well within the technical capability of such a person to combine them without undue experimentation.

2. Specific Motivations to Combine

As described above, each of the independent claims of the '146 patent is generally directed to (a) generating, by using a light source and a pattern generator, a time-varying illumination pattern, (b) illuminating part of an object in an oral cavity with a time-varying illumination pattern, (d) transmitting at least a part of the light returned from the object to a camera to form a plurality of 2D images, and (e) determining a 3D geometry of the object based on the 2D images and the time-varying illumination pattern. The independent claims also recite hardware features of a conventional intraoral scanner, including a camera accommodating an array of sensor elements, a light source, an optical system, and a hardware processor. A

POSITA would have been motivated to add them as one of a limited number of design options available when implementing an intraoral scanner.

The dependent claims add trivial variations to these elements, including the “pattern generator is based on a projector such as a liquid crystal display (LCD) projector or a digital light processing (DLP) projector,” that the light source illuminates different colors and are light-emitting diodes (LEDs) or a segmented LED, that the optical system is “substantially achromatic,” and that the processing of raw 3D data for the 3D geometry is in real time. A POSITA would have been motivated to add each of these features to any of the charted references as part of a limited number of design options that confer known benefits while yielding predictable results.

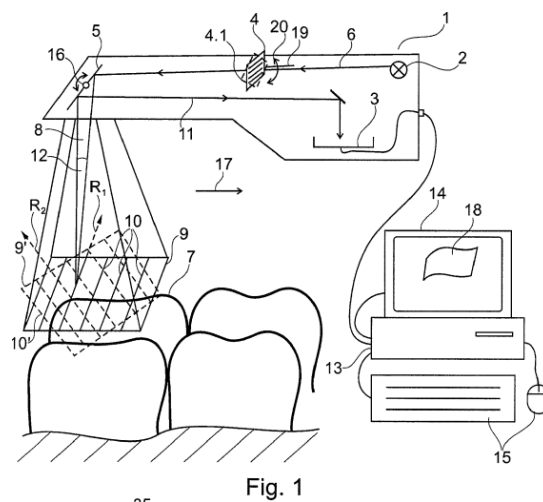
Exemplary motivations to combine each of these features with any of the charted references are described below.

A Pattern Generator and a Time-Varying Illumination Pattern

All independent claims of the '146 patent require a “pattern generator” for generating a probe light in the form of a time-varying illumination pattern. There is nothing inventive, however, about generating a time-varying illumination pattern as claimed by the '146 patent. In fact, the '146 patent admits that time varying patterns and pattern generators were well-known prior to the filing of the '146 patent. *See, e.g.,* '146 patent at 2:25-30 (“In WO 2008/125605, means for generating a time-

variant pattern composed of alternating split images are described.”). By the time of the alleged invention of the ’146 patent, prior art was replete with different techniques of generating a time-varying illumination pattern. For example, U.S. Patent Pub. No. 2009/0087050 (“Gandyra”), published on August 18, 2008, discloses a scanner for scanning a tooth, and includes a projector for projecting a pattern, such as dots, lines or gratings, onto teeth, as a “time variable” pattern. See Gandyra at [0030], [0038].

As yet another example, U.S. Patent No. 8,280,152 (“Thiel”), filed on November 14, 2008, discloses an intraoral dental scanner that projects pattern 9 onto a tooth such that the pattern is incrementally moved in the direction 17 of the plane of triangulation 8. See Thiel at 10:38-11:5 (“With the method of the present invention a plurality of images with the pattern 9 being moved between each exposure by a stripe's width in the direction 17 until the surface of the object 7 has been scanned completely.”), FIG. 1.



As yet another example, “Real-time three-dimensional imaging of macroscopic structures” (“Wilson”), published August 1998, describes projecting a grid pattern onto an object and moving the grid in a “sawtooth fashion.” See Wilson⁴ at 118 (“We introduce a one-dimensional grid pattern into the illumination path of our low-power imaging system so that a grid (fringe) pattern is imaged onto the object. . . . The grid was moved in a simple sawtooth fashion synchronized to the CCD camera frame rate such that three successive camera images correspond to a spatial shift of one-third of a period of the projected image of the grid.”).

As yet another example, “A 3-Dimensional Vision System For Dental Application” (“Zhang”) discloses a Digital light Processing or Liquid Crystal Display (LCD) projector that projects and shifts a stripe pattern across a tooth. See Zhang at 3369, 3371, FIG. 2.

As yet another example, U.S. Patent Publication No. 2005/0088529 (“Geng”), published on April 28, 2005, discloses a method and system for capturing a 3D image, wherein a pattern generator projects a pattern through a projection lens onto an object’s surface. See Geng at [0058] (“After the beam combination is performed by the prisms (830) with 45-degree beam-splitters, the projection optics (840) is able to generate a multi-rainbow projection (850) pattern onto the surface of a desired object.”), [0073] (“The light is then focused on an object surface point l, in front of the imaging plane of the slot plate (1820).”). A micro-switching mechanism of the

pattern generator controls the relative position of the pattern generator, thereby producing a zigzag pattern on the object. See Geng at [0073] (“[P]roper control of the relative position of the projector and the object surface allows the production of a zigzag waveform (1810) on the surface of the object being imaged.”), [0075], [0076], FIG. 18.

Thus, a POSITA would have been motivated to add a pattern generator for generating a time-varying illumination pattern into an intraoral scanner because it was well-known in the industry to obtain improve scanning accuracy.

Optical System

All independent claims of the ’146 patent require a “optical system” for transmitting the probe light along an optical path and illuminate a part of an object in an oral cavity, and for transmitting at least a part of the light returned from the object to at least one camera to form a plurality of 2D images.

Intraoral scanners, long before the alleged invention of the ’146 patent, utilized techniques of confocal laser scanner microscopy (CLSM) and related optical systems to project a probe light to illuminate part of an object in an oral cavity, and transmitting the reflected light to a camera to form 2D images. See ’146 patent at 1:44-65. Such techniques were first developed in the 1960.¹⁸ By the 1980s, CLSM

¹⁸ Logozzo, S, et. al., *Recent advances in dental optics – Part I: 3d intraoral scanners for restorative dentistry*, Opt Laser Eng (2013) at 4.

became a standard technique implemented in intraoral scanners and remains common place today.¹⁹ Against this background, a POSITA would have been strongly motivated to implement CLSM into an intraoral scanner. The combination would have a reasonable expectation of success because it would involve applying a known technique that would yield predictable results.

Moreover, by the time of the alleged invention of the '146 patent, the prior art was replete with different techniques of illuminating a probe light onto an object in an oral cavity, and transmitting the light returned from the object to at least one camera to form a plurality of 2D images. For example, Gandyra discloses an intraoral scanner with a projector that illuminates a pattern along an optical path onto an object, wherein the scanner further includes a camera and recording optics to form a plurality of 2D images. See Gandyra at [0006] (“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. In accordance with the invention, the recording optics comprises a first imaging optics and a second imaging optics. In this way, a stereoscopic pair is produced by the scanner”), [0032] (“In the optical path from the imaging optics 9 to the beam splitter 13 a first mirror 14 is provided, which reflects the light which comes from the first tooth 4 and is projected by the first imaging optics 9 onto the first mirror 15 of the

¹⁹ *Id.*

beam splitter 13. From the mirror surfaces 15, 17 of the beam splitter 13, the light is reflected to a CCD sensor 18. The image from the first imaging optics 9 is projected onto the left half of the CCD sensor 18, the image from the second imaging optics 10 is projected onto the right half of the CCD sensor 18”), [0040] (“A pattern is projected onto the surface, which is observed from two or more directions for generating the digital 3D data and is included in a corresponding number of 2D images.”).

As another example, Zhang discloses projecting a pattern onto a tooth and acquiring an image by a camera to determine the 3D geometry of the tooth. *See* Zhang at 3369 (“The VSDFP system (optical arrangement shown in Figure 1) uses a DLP based LED projector to generate a projection pattern and a CCD camera for image acquisition. . . . This system generates a sinusoidal fringe pattern and uses the projection unit to project the pattern onto the tooth surface being measured. The image captured by the camera is a deformed pattern due to 3-D nature of the tooth surface. The deformed pattern recorded by the camera is digitized into the computer via a frame grabber. The phase distribution of the fringe pattern is deduced, and the 3-D surface information is determined.”).

As another example, U.S. Patent Pub. No. 2010/0253773 (“Oota”) discloses an intraoral measurement device having a projector for a projecting light along a path and onto an object in an oral cavity, and an image processing unit acquiring an

image two-dimensional image. *See* Oota at Abstract (“An intra-oral measurement device according to the present invention is provided with a light projecting unit for irradiating lights in at least two different wavelengths along an identical light axis toward an object to be measured that includes at least a tooth in an oral cavity.”), [0058] (“The image processing unit 40 converts the transferred data of the two-dimensional image into data of three-dimensional coordinates, and obtains three-dimensional image data of the object to be measured 21 for designing and producing a dental prosthesis.”).

As another example, “Miniaturized 3D surface profilometer using digital fringe projection” (“Chen”) discloses a 3D oral probe that projects a light along a path onto a tooth, and the returned light is transmitted to a CCD camera to generate a 2D image. *See* Chen at 1062 (“A halogen lamp light source projected through the DMD chip generates structured light patterns, such as various types of periodic sine waves, concentric circles or dot matrix patterns, which are then projected at an inclination angle onto the object to be measured.”), 1063 (“[T]he DMD is projecting fringes onto the object with a projecting angle α while the CCD is acquiring images with a viewing angle ζ .”), FIG. 2.

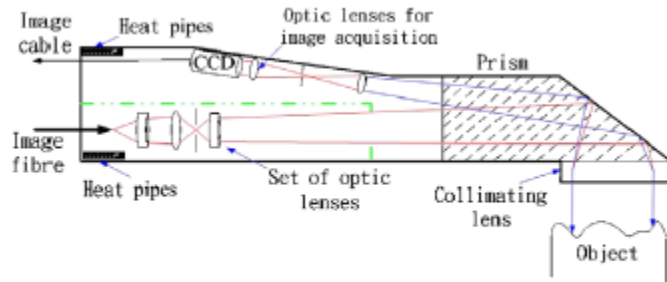


Figure 2. The developed miniaturized mobile probe for 3D surface contour measurement within a restrictive space.

3. Secondary Considerations

Defendants are not aware of objective evidence or secondary considerations demonstrating non-obviousness of the asserted claims of the '146 patent. As set forth below, the evidence confirms that the asserted claims would have been obvious to a person of ordinary skill in the art at the time of the alleged invention. Defendants reserves the right to supplement or modify these factors to address any evidence or arguments later identified by 3Shape.

(a) The Alleged Invention Did Not Satisfy a Long-Felt But Unresolved Need

Defendants are not aware of any evidence of a long-felt but unmet need that the asserted claims solve. On the contrary, the concepts and functions described in the asserted claims of the '146 patent were all well-known before the alleged invention date as evidenced by the patent itself, its file history and the references cited therein, and the prior art Defendants have identified in these contentions and accompanying exhibits.

(b) The Alleged Invention Did Not Face Skepticism or Teaching Away by Experts

Defendants are not aware of any evidence of a failure of others to invent or use the claimed techniques before the alleged invention dates of the '146 patent. As discussed, the '146 patent recites concepts that were already known in the prior art.

(c) The Alleged Invention Was Not Subject to Industry Acceptance

Defendants are not aware of any evidence that 3Shape's alleged invention in the '146 patent was subject to additional industry acceptance due to 3Shape or the '146 patent. This is at least because the subject matter of the '146 patent already existed in the industry and was used by many entities and individuals prior to the '146 patent.

(d) The Alleged Invention Has Not Been Subject to Industry Praise

Defendants are not aware of any evidence of industry praise for any of the alleged inventions of the '146 patent. To the extent any industry praise is related to any functionality that 3Shape alleges practices the '146 patent, that praise is not due to the allegedly novel features of the '146 patent, but instead only to features present in the prior art, which is not a sufficient nexus for purposes of obviousness. See *Muniauction, Inc. v. Thomson Corp.*, 532 F.3d 1318, 1328 (Fed. Cir. 2008).

(e) The Alleged Invention Is Not Responsible for Commercial Success

Defendants are not aware of any evidence of alleged success of any products that is due to the alleged invention claimed in the '146 patent. The patentee bears the burden of demonstrating that the relevant commercial success is attributable to the claimed invention “as opposed to other economic and commercial factors unrelated to the technical quality of the patented subject matter.” *Cable Elec. Prods, Inc. v. Genmark, Inc.*, 770 F. 2d 1015, 1027 (Fed. Cir. 1987). Here, 3Shape has not shown (and cannot show) that any commercial success is due to the alleged invention of the '146 patent. *See Windsurfing Int’l Inc. v. AMF*, 782 F. 2d 995 (Fed. Cir. 1986) (considerations such as intervening, non-covered technological innovations, popularity of accessories, and advertising expense are all relevant to the nexus determination).

Moreover, to the extent any commercial success of any products is due to concepts discussed in the '146 patent, those concepts were already present in the prior art, as described above, and thus does not support any commercial success that is relevant to the question of obviousness. *Tokai Corp. v. Easton Enterprises, Inc.*, 632 F.3d 1358, 1369-70 (Fed. Cir. 2011) (“If commercial success is due to an element in the prior art, no nexus exists.”); *In re Huai-Hung Kao*, 639 F.3d 1057, 1068 (Fed. Cir. 2011) (“Where the offered secondary consideration actually results from something other than what is both claimed and novel in the claim, there is no nexus to the merits of the claimed invention.”); *Ormco Corp. v. Align Tech., Inc.*,

463 F.3d 1299, 1312 (Fed. Cir. 2006) (“[I]f the feature that creates the commercial success was known in the prior art, the success is not pertinent.”).

(f) There Is No Evidence to Show Copying of the Alleged Invention

Defendants are not aware of any evidence of any aspect of the ’146 patent that was copied by any entity or person, much less that any functionality that practices the ’146 patent was copied. *See Amazon.com, Inc. v. Barnesandnoble.com, Inc.*, 239 F.3d 1343, 1366 (Fed. Cir. 2001) (allegedly copied feature must be an embodiment of the patented claims).

(g) Simultaneous Development of the Alleged Invention Confirms that the Asserted Claims Were Obvious

As set forth above, many people and companies independently and simultaneously developed and invented the same technology within a comparatively short space of time of a few years, which further shows that the ’146 patent was the product only of ordinary engineering skill. Moreover, the fact that there was relatively simultaneous invention demonstrates that the subject matter of the ’146 patent was already well within the level of ordinary skill in the art.

D. The ’667 Patent

1. Combinations

The charts identified above in Table 8 and the chart included in Exhibit 667-B (collectively, ’667 Patent Claim Charts) set forth the bases for obviousness, identifying the disclosures of each reference that can be combined on a limitation-

by-limitation basis with disclosures from other references (including the ones identified in Table 8 and in Exhibit 667-B). Each of the '667 Patent Claim Charts demonstrates that the charted references render obvious, based on its disclosure alone or in combination with the knowledge of person of skill in the art or with other charted reference(s), each asserted claim of the '667 patent. Exhibit 667-B identifies numerous disclosures in additional prior art references, any of which would be obvious to combine with one or more of the prior art references charted in the '667 Patent Claim Charts in a predictable way with a reasonable expectation of success to render obvious the claimed invention at issue, to the extent such primary reference is missing the disclosed limitation.

Specifically, if Plaintiff argues that any particular prior art reference lacks any claimed feature, a person of ordinary skill in the art as of the '667 patent's purported invention date would have been motivated to modify the reference to include the allegedly missing claimed feature, or to combine it with other references that include that claimed feature, as disclosed in the aforementioned exhibits. As further discussed in Section V.C.2 below, additional exemplary motivations to combine applicable to each limitation for each of the charted references include the following:

- 1. The charted prior art references are in the same field of endeavor as the '667 patent.** The charted prior art references and the '667 patent generally relate to diagnostic imaging techniques and/or intraoral scanner design, at most addressing one or more distinct functional areas within a broader diagnostic imaging and/or intraoral scanner device design.

2. **The charted prior art references are aimed at solving the same perceived problem as the '667 patent.** The charted prior art references and the '667 patent are generally aimed at enhancing diagnostic imaging techniques and/or intraoral scanner device design, including overcoming problems such as “discriminating out-of-focus information” and providing “a fast scan time.” ‘667 at 2:44-45.
3. **The charted prior art references use similar techniques to solve the same problems.** The charted prior art references generally teach one or more of the same techniques, namely (a) transmitting a probe light towards an object in an oral cavity and thereby illuminating part of the object with a time-varying illumination pattern, (b) forming, by a camera, a plurality of 2D images based on light returned from the object, and (c) determining a 3D geometry on the object based on the 2D images and the time-varying illumination pattern. While claim 1 recites motion sensors to measure three-dimensional motion of the intraoral scanner, the other asserted independent claims (i.e., claims 14 and 26) do not. One of ordinary skill, with knowledge of each of these references, would understand that any feature or function set forth in one of these references could be exchanged or added to the teachings of another with a reasonable expectation of such (and minimal or no hardware changes).
4. **Combining any charted prior art reference with one or more of the other charted prior art references would have been a predictable combination.** It would have been entirely predictable to a person of ordinary skill in the art at the time of the alleged invention to combine any of the charted prior art references with one or more of the other charted prior art references. As mentioned, all of these references are in the diagnostic imaging and/or intraoral scanner space and disclose similar designs. Given the finite number of identified, predictable solutions in the diagnostic imaging or intraoral scanner space and the common components and techniques with which to work, it would have been obvious to a person of ordinary skill in the art at the time of the alleged invention to try to combine any of the charted prior art references with one or more of the other charted prior art references.
5. **Combining any charted prior art reference with one or more of the other charted prior art references would have yielded no unexpected results.** The combination of the teachings of any charted prior art reference with one or more of the other charted prior art

references would not have yielded any unexpected result or resulted in any inoperable combination because it would simply be implementing minor, straightforward, and/or well-known variations in diagnostic imaging device design to achieve slight variations in the operation of the device.

- 6. A person of ordinary skill in the art at the time of the alleged invention would have had a reasonable expectation of success in combining any charted prior art reference with one or more of the other charted prior art references.** All the above reasons—for example, the predictability of the combination, the lack of unexpected results, and the similarity in the disclosures of the charted prior art references—would have led a person of ordinary skill in the art at the time of the alleged invention to have a reasonable expectation of success in combining the teachings of any one or more of these references, and it would have been well within the technical capability of such a person to combine them without undue experimentation.

2. Specific Motivations to Combine

As described above, each of the independent claims of the '667 patent is generally directed to (a) generating, by using a light source and a pattern generator, a time-varying illumination pattern, (b) illuminating part of an object in an oral cavity with a time-varying illumination pattern, (d) transmitting at least a part of the light returned from the object to a camera to form a plurality of 2D images, and (e) determining a 3D geometry of the object based on the 2D images and the time-varying illumination pattern. Claim 1 also recites motion sensors located on the intraoral scanner to measure three-dimensional motion. The independent claims also recite hardware features of a conventional intraoral scanner, including a camera accommodating an array of sensor elements, a light source, an optical system, and a

hardware processor. A POSITA would have been motivated to add them as one of a limited number of design options available when implementing an intraoral scanner.

The dependent claims add trivial variations to these elements, including that “the light source further comprises at least three monochromatic light sources configured to provide different colors,” that the processing of raw 3D data for the 3D geometry is in real time, and a hardware processor that is configured to output data from the motion sensors for remotely controlling an image displayed on a display device based on acquired scan data. A person of ordinary skill would have been motivated to add each of these features to any of the charted references as part of a limited number of design options that confer known benefits while yielding predictable results.

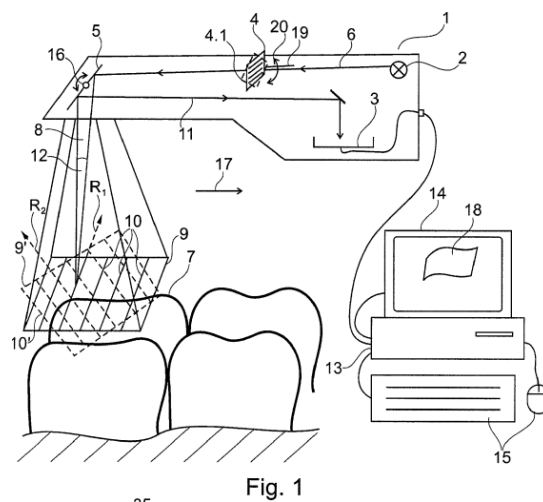
Exemplary motivations to combine each of these features with any of the charted references are described below.

A Pattern Generator and a Time-Varying Illumination Pattern

All independent claims of the '667 patent require a “pattern generator” for generating a probe light in the form of a time-varying illumination pattern. There is nothing inventive, however, about generating a time-varying illumination pattern as claimed by the '667 patent. In fact, the '667 patent admits that time varying patterns and pattern generators were well-known prior to the filing of the '667 patent. *See, e.g.,* '667 patent at 2:28-29 (“In WO 2008/125605, means for generating a time-

variant pattern composed of alternating split images are described.”). By the time of the alleged invention of the ’667 patent, prior art was replete with different techniques of generating a time-varying illumination pattern. For example, U.S. Patent Pub. No. 2009/0087050 (“Gandyra”), published on August 18, 2008, discloses a scanner for scanning a tooth, and includes a projector for projecting a pattern, such as dots, lines or gratings, onto teeth, as a “time variable” pattern. See Gandyra at [0030], [0038].

As another example, U.S. Patent No. 8,280,152 (“Thiel”), filed on November 14, 2008, discloses an intraoral dental scanner that projects pattern 9 onto a tooth such that the pattern is incrementally moved in the direction 17 of the plane of triangulation 8. See Thiel at 10:38-11:5 (“With the method of the present invention a plurality of images with the pattern 9 being moved between each exposure by a stripe's width in the direction 17 until the surface of the object 7 has been scanned completely.”), FIG. 1.



As yet another example, “Real-time three-dimensional imaging of macroscopic structures” (“Wilson”), published August 1998, describes projecting a grid pattern onto an object and moving the grid in a “sawtooth fashion.” See Wilson at 118 (“We introduce a one-dimensional grid pattern into the illumination path of our low-power imaging system so that a grid (fringe) pattern is imaged onto the object. . . . The grid was moved in a simple sawtooth fashion synchronized to the CCD camera frame rate such that three successive camera images correspond to a spatial shift of one-third of a period of the projected image of the grid.”).

As yet another example, “A 3-Dimensional Vision System For Dental Application” (“Zhang”) discloses a Digital light Processing or Liquid Crystal Display (LCD) projector that projects and shifts a stripe pattern across a tooth. See Zhang at 3369, 3371, FIG. 2.

As yet another example, U.S. Patent Publication No. 2005/0088529 (“Geng”), published on April 28, 2005, discloses a method and system for capturing a 3D image, wherein a pattern generator projects a pattern through a projection lens onto an object’s surface. See Geng at [0058] (“After the beam combination is performed by the prisms (830) with 45-degree beam-splitters, the projection optics (840) is able to generate a multi-rainbow projection (850) pattern onto the surface of a desired object.”), [0073] (“The light is then focused on an object surface point l, in front of the imaging plane of the slot plate (1820).”). A micro-switching mechanism of the

pattern generator controls the relative position of the pattern generator, thereby producing a zigzag pattern on the object. See Geng at [0073] (“[P]roper control of the relative position of the projector and the object surface allows the production of a zigzag waveform (1810) on the surface of the object being imaged.”), [0075], [0076], FIG. 18.

Thus, a person of ordinary skill would have been motivated to add a pattern generator for generating a time-varying illumination pattern into an intraoral scanner because it was well-known in the industry to obtain improve scanning accuracy.

Optical System

All independent claims of the ’667 patent require a “optical system” for transmitting the probe light along an optical path and illuminate a part of an object in an oral cavity, and for transmitting at least a part of the light returned from the object to at least one camera to form a plurality of 2D images.

Intraoral scanners, long before the alleged invention of the ’146 patent, utilized techniques of confocal laser scanner microscopy (CLSM) and related optical systems to project a probe light to illuminate part of an object in an oral cavity, and transmitting the reflected light to a camera to form 2D images. See ’146 patent at 1:44-65. Such techniques were first developed in the 1960.²⁰ By the 1980s, CLSM

²⁰ Logozzo, S, et. al., *Recent advances in dental optics – Part I: 3d intraoral scanners for restorative dentistry*, Opt Laser Eng (2013) at 4.

became a standard technique implemented in intraoral scanners and remains common place today.²¹ Against this background, a person of ordinary skill in the art would have been strongly motivated to implement CLSM into an intraoral scanner. The combination would have a reasonable expectation of success because it would involve applying a known technique that would yield predictable results.

Moreover, by the time of the alleged invention of the '146 patent, the prior art was replete with different techniques of illuminating a probe light onto an object in an oral cavity, and transmitting the light returned from the object to at least one camera to form a plurality of 2D images. For example, Gandyra discloses an intraoral scanner with a projector that illuminates a pattern along an optical path onto an object, wherein the scanner further includes a camera and recording optics to form a plurality of 2D images. See Gandyra at [0006] (“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. In accordance with the invention, the recording optics comprises a first imaging optics and a second imaging optics. In this way, a stereoscopic pair is produced by the scanner”), [0032] (“In the optical path from the imaging optics 9 to the beam splitter 13 a first mirror 14 is provided, which reflects the light which comes from the first tooth 4 and is projected by the first imaging optics 9 onto the first mirror 15 of the

²¹ *Id.*

beam splitter 13. From the mirror surfaces 15, 17 of the beam splitter 13, the light is reflected to a CCD sensor 18. The image from the first imaging optics 9 is projected onto the left half of the CCD sensor 18, the image from the second imaging optics 10 is projected onto the right half of the CCD sensor 18”), [0040] (“A pattern is projected onto the surface, which is observed from two or more directions for generating the digital 3D data and is included in a corresponding number of 2D images.”).

As another example, Zhang discloses projecting a pattern onto a tooth and acquiring an image by a camera to determine the 3D geometry of the tooth. *See* Zhang at 3369 (“The VSDFP system (optical arrangement shown in Figure 1) uses a DLP based LED projector to generate a projection pattern and a CCD camera for image acquisition. . . . This system generates a sinusoidal fringe pattern and uses the projection unit to project the pattern onto the tooth surface being measured. The image captured by the camera is a deformed pattern due to 3-D nature of the tooth surface. The deformed pattern recorded by the camera is digitized into the computer via a frame grabber. The phase distribution of the fringe pattern is deduced, and the 3-D surface information is determined.”).

As another example, U.S. Patent Pub. No. 2010/0253773 (“Oota”) discloses an intraoral measurement device having a projector for a projecting light along a path and onto an object in an oral cavity, and an image processing unit acquiring an

image two-dimensional image. *See* Oota at Abstract (“An intra-oral measurement device according to the present invention is provided with a light projecting unit for irradiating lights in at least two different wavelengths along an identical light axis toward an object to be measured that includes at least a tooth in an oral cavity.”), [0058] (“The image processing unit 40 converts the transferred data of the two-dimensional image into data of three-dimensional coordinates, and obtains three-dimensional image data of the object to be measured 21 for designing and producing a dental prosthesis.”).

As another example, “Miniaturized 3D surface profilometer using digital fringe projection” (“Chen”) discloses a 3D oral probe that projects a light along a path onto a tooth, and the returned light is transmitted to a CCD camera to generate a 2D image. *See* Chen at 1062 (“A halogen lamp light source projected through the DMD chip generates structured light patterns, such as various types of periodic sine waves, concentric circles or dot matrix patterns, which are then projected at an inclination angle onto the object to be measured.”), 1063 (“[T]he DMD is projecting fringes onto the object with a projecting angle α while the CCD is acquiring images with a viewing angle ζ .”), FIG. 2.

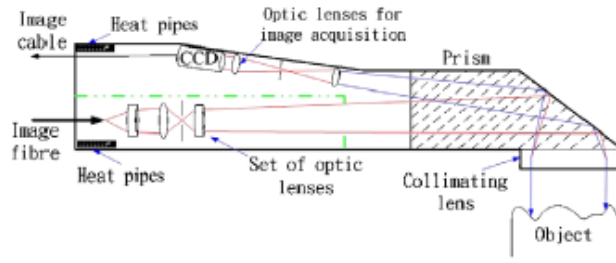


Figure 2. The developed miniaturized mobile probe for 3D surface contour measurement within a restrictive space.

Motion Sensors

Independent claims 1 and 26, and dependent claim 16, recite that one or more motion sensors are located on the intraoral scanner to measure three-dimensional motion of the intraoral scanner. There is nothing inventive, however, about the use of motion sensors in intraoral scanners, as claimed by the '667 patent.

Motion sensors were first developed in the 1940s during World War II.²² Since then, motion sensors have been used in a variety of fields (e.g., gaming²³ and medical²⁴). By 2008, intraoral scanners incorporated motion sensors to improve scanning accuracy when rotating the device during a scan.²⁵ Indeed, the '667 patent also explains that the motion sensors can improve scanning accuracy by measuring

²² See Coulombe, <https://www.securityinfowatch.com/alarms-monitoring/alarm-systems-intrusion-detection/article/21219314/tech-trends-the-next-evolution-of-motion-detection>

²³ U.S. Patent No. 7,774,155 at Abstract.

²⁴ U.S. Patent No. 6,721,386.

²⁵ S Logozzo, G Franceschini, A Kilpelä, M Caponi, L Governi, L Blois. A Comparative Analysis Of Intraoral 3d Digital Scanners For Restorative Dentistry. The Internet Journal of Medical Technology. 2008 Volume 5 Number 1 at 8-9 (discussing the Lava C.O.S., and the 3D-in-Motion technology).

all motion in 3D, by detecting vibrations and/or shaking and thus discarding or correcting the scan by utilizing image stabilization techniques. *See* '667 patent at 24:12-22. By the time of the alleged invention of the '667 patent, prior art was replete with utilizing motion sensors in intraoral scanners. For example, U.S. Patent Pub. No. 2005/0237581 ("Knighton"), discloses that the scanning device could include a position tracking device, which could be an accelerometer, that generates movement output data indicating movement of the device. *See* Knighton at [0044] ("Position tracking or detection sensor 321 may be a single device or combination of devices. The devices may include a gyroscope, global position device, altimeter or similar device that detects the orientation and position of the device in three-dimensional space. In one embodiment, a set of gyroscopes and accelerometers may be used for each of an x, y and z axis. The position detection or tracking device may generate positions or movement output data that indicate the position or movement of the device that may be used by software executing on processor 301 or a remote computing device to generate the three dimensional representation of a target.").

As another example, U.S. Patent No. 8,914,245 ("Hopkins") discloses an ultrasonic probe with an accelerometer to detect linear and rotational movement of the probe. *See* Hopkins at 2:49-55, 5:50-55 ("The MEMS 32 accelerometer sensor automatically senses when the probe 10 is rotated 90°.").

As another example, U.S. Patent Pub. No. 2005/0212756 (“Marvit”) discloses that a motion sensor 22 that includes accelerometers to detect movement of a device. *See* Serra at [0043] (“Accelerometers 24a, 24b and 24c detect movement of the device by detecting acceleration along a respective sensing axis.”).

As another example, U.S. Patent Pub. No. 2009/0092955 (“Hwang”) discloses a toothbrushing pattern correcting device that includes an acceleration sensor. *See* Hwang at [0069] (“A case where the sensing unit 128 of the tooth brushing pattern analyzing/correcting device 100 has a three-axis (X, Y, Z) acceleration sensor 154.”).

As another example, “Tele-3D – Developing a Handheld Scanner Using Structured Light Projection” (“Ferreira”) discloses a 3D scanner having an accelerometer. *See* Ferreira at 2.

3. Secondary Considerations

Defendants are not aware of objective evidence or secondary considerations demonstrating non-obviousness of the asserted claims of the ’667 patent. As set forth below, the evidence confirms that the asserted claims would have been obvious to a person of ordinary skill in the art at the time of the alleged invention. Defendants reserves the right to supplement or modify these factors to address any evidence or arguments later identified by 3Shape.

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Defendants are not aware of any evidence of a failure of others to invent or use the claimed techniques before the alleged invention dates of the '667 patent. As discussed, the '667 patent recites concepts that were already known in the prior art.

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(e) The Alleged Invention Is Not Responsible for Commercial Success

Defendants are not aware of any evidence of alleged success of any products that is due to the alleged invention claimed in the '667 patent. The patentee bears the burden of demonstrating that the relevant commercial success is attributable to the claimed invention “as opposed to other economic and commercial factors unrelated to the technical quality of the patented subject matter.” *Cable Elec. Prods, Inc. v. Genmark, Inc.*, 770 F. 2d 1015, 1027 (Fed. Cir. 1987). Here, 3Shape has not shown (and cannot show) that any commercial success is due to the alleged invention of the '667 patent. See *Windsurfing Int’l Inc. v. AMF*, 782 F. 2d 995 (Fed. Cir. 1986) (considerations such as intervening, non-covered technological innovations, popularity of accessories, and advertising expense are all relevant to the nexus determination).

Moreover, to the extent any commercial success of any products is due to concepts discussed in the '667 patent, those concepts were already present in the

prior art, as described above, and thus does not support any commercial success that is relevant to the question of obviousness. *Tokai Corp. v. Easton Enterprises, Inc.*, 632 F.3d 1358, 1369-70 (Fed. Cir. 2011) (“If commercial success is due to an element in the prior art, no nexus exists.”); *In re Huai-Hung Kao*, 639 F.3d 1057, 1068 (Fed. Cir. 2011) (“Where the offered secondary consideration actually results from something other than what is both claimed and novel in the claim, there is no nexus to the merits of the claimed invention.”); *Ormco Corp. v. Align Tech., Inc.*, 463 F.3d 1299, 1312 (Fed. Cir. 2006) (“[I]f the feature that creates the commercial success was known in the prior art, the success is not pertinent.”).

(f) There Is No Evidence to Show Copying of the Alleged Invention

Defendants are not aware of any evidence of any aspect of the '667 patent that was copied by any entity or person, much less that any functionality that practices the '667 patent was copied. *See Amazon.com, Inc. v. Barnesandnoble.com, Inc.*, 239 F.3d 1343, 1366 (Fed. Cir. 2001) (allegedly copied feature must be an embodiment of the patented claims).

(g) Simultaneous Development of the Alleged Invention Confirms that the Asserted Claims Were Obvious

As set forth above, many people and companies independently and simultaneously developed and invented the same technology within a comparatively short space of time of a few years, which further shows that the '667

patent was the product only of ordinary engineering skill. Moreover, the fact that there was relatively simultaneous invention demonstrates that the subject matter of the '667 patent was already well within the level of ordinary skill in the art.

VI. 35 U.S.C. § 112

The claims of the Asserted Patents are invalid under 35 U.S.C. § 112 at least for being indefinite, not enabled, and lacking written description support.

The Asserted Claims recite several terms that fail to inform the person of ordinary skill in the art about the scope of the claims with reasonable certainty. By way of example only, and without limitation, the asserted claims recite and are rendered indefinite by one or more of the following terms:

A. '221 Patent

- In claims 1, 2, 5, 9, and 10, “the 3D environment” is indefinite;
- In claims 1, 19, and 33, “the physical 3D environment” is indefinite;
- In claims 1, 6, and 23, “the 3D user interface” is indefinite;
- In claims 1, 5, 7, 19, 20, 21, 22, 23, 28, and 33, “at least one motion sensor” is indefinite and lacks sufficient written description;
- In claims 1 and 19, “wherein the at least one motion sensor is a sensor that directly detects motion” is indefinite and lacks sufficient written description;
- In claims 6 and 7, “gestures” is indefinite;
- In claim 22, “sensor fusion” is indefinite and lacks sufficient written description.

- In claim 28, “wherein the at least one motion sensor and/or the user-interface element are utilized in a workflow” is indefinite and lacks sufficient written description;
- In claim 34, “wherein the handheld device further comprises at least two user interface elements” is indefinite.

B. '151 Patent

- In claims 1, 13, and 14, “determining a tooth shade value for at least one point on the tooth based on the texture data of the corresponding point of the digital 3D representation” is indefinite, particularly read in light of claim 11, “wherein the texture information comprises at least one of tooth color or surface roughness”;
- In claim 13, “wherein the tooth shade profile comprises a one or more tooth shade regions on the tooth surface where an average tooth shade is derived for each region from tooth shade values determined for a number of points within the region” is indefinite;
- In claim 1, “deriving a certainty score” is indefinite;
- In claims 1-3, 7, 10, 13-15, “texture data” is indefinite;
- In claims 1-3, 13, and 14, “texture value” is indefinite;
- In claims 1, 7, 11, 14, 15, 16, and 17, “texture information” is indefinite;
- In claims 7, 14, 15, and 16, “sub-scans” is indefinite;
- In claim 7, “the certain measure” is indefinite;
- In claim 7, “the sub-scan texture information” is indefinite;
- In claim 12, “determined one or more points on the tooth,” is indefinite;
- In claim 14, “geometry information” is indefinite and lacks sufficient written description;
- In claim 14, “shape data” is indefinite and lacks sufficient written description;

- In claim 9, “teeth prepared for a dental restoration” is indefinite and lacks sufficient written description;
- In claim 14, “obtaining the digital 3D representation of the tooth comprises recording a series of sub-scans of the tooth” is indefinite;
- In claim 14, “generating the digital 3D representation of the tooth from the recorded series of sub-scans” is indefinite; and
- In claim 15, “wherein the texture data are at least partly derived by combining the texture information from corresponding parts of a number of the sub-scans” is indefinite.

C. '146 Patent

- In claim 8, “wherein the probe light is directed towards the object in a direction substantially parallel with the longitudinal axis of the tip” is indefinite;
- In claims 1, 21 “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” is indefinite;
- In claim 1, “a tip configured to be inserted into the oral cavity” is indefinite;
- In claim 21, “a tip of intraoral scanner inserted into the oral cavity” is indefinite;
- In claim 1, “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” is indefinite;
- In claim 1, “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” is indefinite;

- In claim 1, “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” is indefinite;
- In claim 1, “wherein the intraoral scanner is wireless” is indefinite;
- In claims 1, 16, and 22, “high-speed” is indefinite;
- In claims 12, 21, and 24, ““data for the 3D geometry” is indefinite;
- In claim 21, “the data for the 3D geometry” is indefinite;
- In claim 7, “substantially achromatic” is indefinite and lacks sufficient written description;
- In claim 8, “substantially parallel” is indefinite and lacks sufficient written description;
- In claim 13, “wherein a temporal correlation measure is computed with sensor signals” is indefinite;
- In claim 8, “wherein the probe light is directed towards the object in a direction substantially parallel with the longitudinal axis of the tip, and wherein the probe light is further reflected towards the object by a single reflective mirror located in the tip” is indefinite;
- In claim 15, “wherein the temporal correlation measure is based on a reference signal that is based on knowledge or on calibration of the plurality of configurations of the time-varying illumination pattern” is indefinite;
- In claims 12, 21, and 24, “data for the 3D geometry” is indefinite.
- In claim 27, “where the method further comprises a step of computing a temporal correlation measure with sensor signals” is indefinite; and
- In claims 9, 10, 12, 23, 24: “raw 3D data” is indefinite and lacks written description;

D. '667 Patent

- In claims 1, 14, 26, “time-varying illumination pattern” is indefinite;
- In claim 1, 14, 26, “a tip configured to be inserted into the oral cavity” is indefinite;
- In claims 1, 14, and 26, “a tip configured to be inserted into the oral cavity”
- In claims 1, 14, and 26, “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”
- In claims 1, 14, and 26, “a hardware processor, located within the wireless intraoral scanner, configured to: selectively switch a color of the probe light to illuminate the object with different colors at different times; and record images of the object with the different colors by recording different images by the at least one camera at the different times.”
- In claims 5, 22, “wherein the optical system is [further] configured to direct the probe light towards the object in a direction substantially parallel with the longitudinal axis of the tip” is indefinite;
- In claims 8 and 15, “data for the 3D geometry” is indefinite;
- In claims 1, 14, and 29, “wherein the intraoral scanner is wireless” is indefinite;
- In claims 8 and 15, “data for the 3D geometry” is indefinite;
- In claim 13, “wherein a temporal correlation measure is computed with sensor signals” is indefinite;
- In claims 1, 14, 26: “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” is indefinite; and
- In claims 6, 7, 8, 14, 15, 29: “raw 3D data” is indefinite and lacks written description.

VII. 35 U.S.C. § 101

Defendants incorporate by reference their Partial Motion to Dismiss Pursuant to Fed. R. Civ. P. 12(b)(6) herein. Claims 1-3, 6, 7, and 9-17 of the '151 patent are directed to patent ineligible subject matter under Section 101. Defendants' § 101 contentions as set out in their Partial Motion to Dismiss (1) identify the alleged abstract idea, law of nature, and/or natural phenomenon in each challenged claim; (2) identify each claim element alleged to be well-understood, routine, and/or conventional; and (3) to the extent not duplicative of 102/103 prior art contentions, provide prior art for the contention that claim elements are well-understood, routine, and/or conventional. These contentions are to be read in conjunction with the accompanying claim charts.

VIII. INEQUITABLE CONDUCT

The asserted claims of the '221 Patent are invalid under the doctrine of inequitable conduct. For inequitable conduct to exist, the applicant must have made a deliberate decision to withhold a known material reference. *See Therasense, Inc. v. Becton, Dickinson & Co.*, 649 F.3d 1276, 1290 (Fed. Cir. 2011). 3Shape deliberately withheld material information regarding the PTAB's finding of invalidity of U.S. Patent No. 9,329,675 ("the '675 Patent"), the original patent from which '221 Patent reissued, with the intent to deceive the PTAB.

In IPR2018-00197, the Board found that Kriveshko invalidated almost all the '675 patent claim elements. *See Align Technology Inc. v. 3Shape A/S*, IPR2018-00197, Final Written Decision, Paper No. 22 (May 29, 2019). The Board also found that Serra invalidated '675 patent claim 19's "3D sensor" that can sense the motion of a handheld probe by tracking its position and orientation because Serra teaches that "a button can be used to use the probe to scan an image or to use it to rotate the entire virtual scene," recognizing that this was "a common 3D data set interactive visualization operation." *Id.*, 39, 51-59. The Board further found that Serra's "3D sensor" senses motion through tracking position and orientation and rotates "the 3D data presented on the display using tracking information corresponding to the movement of the scanning device." *Id.*, 54. Given these teachings, the Board found that it would have been obvious to incorporate Serra's 3D user interface into Kriveshko's scanning device in light of the "ergonomic benefits of modifying a scanning device to include the ability to adjust display parameters." *Id.* at 42.

3Shape did not appeal the PTAB's adverse finding and instead filed Reissue Application 16/526,281, seeking substantively the same claims as invalidated claims 1 and 19 of the '67 patent and adding only the "wherein the at least one motion sensor is an accelerometer, gyro, or magnetometer" limitation. The chart below summarizes the changes that 3Shape made between claims 1 and 19 of the '675 Patent, and claim 33 of the '221 patent:

'675 Patent Claim 1 (Brackets Denote Language Present in Claim 19)	'221 Patent Claim 33
A scanning system for scanning a 3D environment, the scanning system comprising:	Same
a handheld device including an optical scanner, wherein the 3D environment to be scanned is selected by pointing the optical scanner at the 3D environment; and	Same
at least one display remotely connected to the handheld device,	Same
wherein the handheld device is adapted for performing at least one scanning action in a physical 3D environment, and the at least one display is adapted for visually representing the physical 3D environment; and	Same
the handheld device includes [[a user interface]] ²⁶ for remotely controlling the display to adjust the view with which the 3D environment is represented on the display	wherein the handheld device includes <u>at least one motion sensor</u> for remotely controlling the display to adjust the view with which the 3D environment is represented on the display; and
	<u>wherein the at least one motion sensor is an accelerometer, gyro, or magnetometer.</u>

²⁶ '675 Claim 19 recites “and that the view is remotely controlled by at least one motion sensor arranged in the handheld device.”

While the '221 Patent adds that the motion sensor is an “accelerometer, gyro, or magnetometer,” these are indisputably well-known variants of motion sensors, a limitation the Board already found was disclosed in the prior art in finding the challenged claims of the '675 patent invalid. See IPR2018-00197, Final Written Decision at 16, 52-59. Indeed, the '221 Patent indicates as much, and the claim limitation added to the '221 patent is nothing more than an indiscriminate list of the three species. See '221 Patent, Claim 33. Defendants' prior art discussed herein and Defendants' charts further demonstrate that accelerometers, gyros, and magnetometers were conventional and routinely motion sensors known and used long before the alleged priority date of the '221 Patent. Listing conventional species of a motion sensor does not render the '221 Patent anymore valid than what the Board previously invalidated.

During prosecution of the '221 Patent, 3Shape did not disclose the IPR certificate or notify the USPTO that the subject matter of claims 1-19 had been invalidated by the PTAB. Nor did 3Shape file a Rule 1.183 Petition, in accordance with M.P.E.P. § 1449.01(A)(5) and as required by Rule 42.73(d)(3)(i). 3Shape did not “call to the attention” of the Examiner the outcome of the IPR in any way, as required by Rule 1.178(b). Each of these three transgressions are material omissions in its own right. See *GFI, Inc. v. Franklin Corp.*, 265 F.3d 1268, 1274 (Fed. Cir. 2001) (“Materiality is not limited to prior art but instead embraces any information

that a reasonable examiner would be substantially likely to consider important in deciding whether to allow an application to issue as a patent.”).

Furthermore, 3Shape indisputably knew of the invalidation of the ’675 patent and yet knowingly refused to disclose any such information during the reissuance proceedings. *See id.* (finding “the strongest case for deceptive intent [was that]...GFI was aware of the references). Had the Examiner been informed of the IPR decisions, 3Shape’s proposed amendments to the claims of the ’221 patent would not have overcome the rejections issued against the ’675 patent in IPR2018-00197. Such actions demonstrate 3Shape’s deceptive intent. *See GFI, Inc.*, 265 F.3d 1268, 1275 (“We have held deceptive intent to be shown where a patentee withheld references and made an argument for patentability that could not have been made had the art been disclosed.”).

In summary, 3Shape was well aware of the invalidated claims of the ’675 Patent and refused to inform the Examiner of the Board’s Final Written Decision during the prosecution of the ’221 patent because it knew that the amendments to the ’221 patent claims could not overcome the Board’s reasons for invalidation. These material omissions led to reissue claims that are not patentably distinct from the claims that were invalidated and should not have been allowed. As such, the asserted claims of the ’221 Patent are invalid under the doctrine of inequitable conduct.

IX. DOCUMENT PRODUCTION

Pursuant to Local Patent Rule 4.3(b), Defendants produce herewith a copy of each item of prior art identified herein comprising a printed publication at DITC000000001 to DITC000000648 and incorporate by reference the production made to 3Shape in Western District of Texas, Case No. 6:21-CV-1110-ADA, including the documents produced at CSD-0028541 to CSD-0032230.

Dated: November 7, 2022

Respectfully submitted,

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CERTIFICATE OF SERVICE

The undersigned hereby certifies that a true and correct copy of the above and foregoing document has been served on November 7, 2022 via email.

/s/ Robin Lynn McGrath

Robin Lynn McGrath

Quinn Emanuel Urquhart & Sullivan

LLP