UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	ISSUE DATE	PATENT NO.	ATTORNEY DOCKET NO.	CONFIRMATION NO.
16/160,230	02/01/2022	11234798	208764-9006-US02	8509

129916 7590 01/12/2022

Michael Best & Friedrich LLP (DITC)
790 N WATER ST
SUITE 2500
MILWAUKEE, WI 53202

ISSUE NOTIFICATION

The projected patent number and issue date are specified above.

Determination of Patent Term Adjustment under 35 U.S.C. 154 (b)
(application filed on or after May 29, 2000)

The Patent Term Adjustment is 0 day(s). Any patent to issue from the above-identified application will include an indication of the adjustment on the front page.

If a Continued Prosecution Application (CPA) was filed in the above-identified application, the filing date that determines Patent Term Adjustment is the filing date of the most recent CPA.

Applicant will be able to obtain more detailed information by accessing the Patent Application Information Retrieval (PAIR) WEB site (http://pair.uspto.gov).

Any questions regarding the Patent Term Extension or Adjustment determination should be directed to the Office of Patent Legal Administration at (571)-272-7702. Questions relating to issue and publication fee payments should be directed to the Application Assistance Unit (AAU) of the Office of Data Management (ODM) at (571)-272-4200.

INVENTOR(s) (Please see PAIR WEB site http://pair.uspto.gov for additional inventors):

Robert F. Dillon, Bedford, NH;
Craig A. Andreiko, Residence Not Provided;
Andrew F. Vesper, Townsend, MA;
Neil H.K. Judell, Cambridge, MA;
Timothy I. Fillion, Bedford, MA;

APPLICANT(s) (Please see PAIR WEB site http://pair.uspto.gov for additional applicants):

ORMCO CORPORATION, Orange, CA;

The United States represents the largest, most dynamic marketplace in the world and is an unparalleled location for business investment, innovation, and commercialization of new technologies. The USA offers tremendous resources and advantages for those who invest and manufacture goods here. Through SelectUSA, our nation works to encourage and facilitate business investment. To learn more about why the USA is the best country in the world to develop technology, manufacture products, and grow your business, visit SelectUSA.gov.

3SHAPE EXHIBIT 1002
3Shape v. DITC
IPR2024-00549

PART B - FEE(S) TRANSMITTAL

Complete and send this form, together with applicable fee(s), by mail or fax, or via EFS-Web.

By mail, send to: Mail Stop ISSUE FEE
Commissioner for Patents
P.O. Box 1450
Alexandria, Virginia 22313-1450

By fax, send to: (571)-273-2885

INSTRUCTIONS: This form should be used for transmitting the ISSUE FEE and PUBLICATION FEE (if required). Blocks 1 through 5 should be completed where appropriate. All further correspondence including the Patent, advance orders and notification of maintenance fees will be mailed to the current correspondence address as indicated unless corrected below or directed otherwise in Block 1, by (a) specifying a new correspondence address; and/or (b) indicating a separate "FEE ADDRESS" for maintenance fee notifications.

CURRENT CORRESPONDENCE ADDRESS (Note: Use Block 1 for any change of address)

129916 7590 09/22/2021
Michael Best & Friedrich LLP (DITC)
790 N WATER ST
SUITE 2500
MILWAUKEE, WI 53202

Note: A certificate of mailing can only be used for domestic mailings of the Fee(s) Transmittal. This certificate cannot be used for any other accompanying papers. Each additional paper, such as an assignment or formal drawing, must have its own certificate of mailing or transmission.

Certificate of Mailing or Transmission

I hereby certify that this Fee(s) Transmittal is being deposited with the United States Postal Service with sufficient postage for first class mail in an envelope addressed to the Mail Stop ISSUE FEE address above, or being transmitted to the USPTO via EFS-Web or by facsimile to (571) 273-2885, on the date below.

Susan Kim	(Typed or printed name)
/susan kim/	(Signature)
December 21, 2021	(Date)

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
16/160,230	10/15/2018	Robert F. Dillon	208764-9006-US02	8509

TITLE OF INVENTION: SCANNING SEQUENCE FOR AN INTRA-ORAL IMAGING SYSTEM

APPLN. TYPE	ENTITY STATUS	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	UNDISCOUNTED	$1200	$0.00	$0.00	$1200	12/22/2021

EXAMINER	ART UNIT	CLASS-SUBCLASS
BALI, VIKKRAM	2663	382-128000

1. Change of correspondence address or indication of "Fee Address" (37 CFR 1.363).

❑ Change of correspondence address (or Change of Correspondence Address form PTO/SB/122) attached.

❑ "Fee Address" indication (or "Fee Address" Indication form PTO/SB/47; Rev 03-09 or more recent) attached. **Use of a Customer Number is required.**

2. For printing on the patent front page, list
(1) The names of up to 3 registered patent attorneys or agents OR, alternatively,
(2) The name of a single firm (having as a member a registered attorney or agent) and the names of up to 2 registered patent attorneys or agents. If no name is listed, no name will be printed.

1 Michael Best & Friedrich LLP
2
3

3. ASSIGNEE NAME AND RESIDENCE DATA TO BE PRINTED ON THE PATENT (print or type)

PLEASE NOTE: Unless an assignee is identified below, no assignee data will appear on the patent. If an assignee is identified below, the document must have been previously recorded, or filed for recordation, as set forth in 37 CFR 3.11 and 37 CFR 3.81(a). Completion of this form is NOT a substitute for filing an assignment.

(A) NAME OF ASSIGNEE: ORMCO CORPORATION

(B) RESIDENCE: (CITY and STATE OR COUNTRY): ORANGE, CALIFORNIA

Please check the appropriate assignee category or categories (will not be printed on the patent) : ❑ Individual ☒ Corporation or other private group entity ❑ Government

4a. Fees submitted: ☒ Issue Fee ❑ Publication Fee (if required) ❑ Advance Order - # of Copies _____

4b. Method of Payment: *(Please first reapply any previously paid fee shown above)*

☒ Electronic Payment via EFS-Web ❑ Enclosed check ❑ Non-electronic payment by credit card (Attach form PTO-2038)

☒ The Director is hereby authorized to charge the required fee(s), any deficiency, or credit any overpayment to Deposit Account No. 13-3080

5. **Change in Entity Status** (from status indicated above)

❑ Applicant certifying micro entity status. See 37 CFR 1.29

❑ Applicant asserting small entity status. See 37 CFR 1.27

❑ Applicant changing to regular undiscounted fee status.

NOTE: Absent a valid certification of Micro Entity Status (see forms PTO/SB/15A and 15B), issue fee payment in the micro entity amount will not be accepted at the risk of application abandonment.
NOTE: If the application was previously under micro entity status, checking this box will be taken to be a notification of loss of entitlement to micro entity status.
NOTE: Checking this box will be taken to be a notification of loss of entitlement to small or micro entity status, as applicable.

NOTE: This form must be signed in accordance with 37 CFR 1.31 and 1.33. See 37 CFR 1.4 for signature requirements and certifications.

Authorized Signature /andrew.j.paprocki/ Date December 21, 2021

Typed or printed name Andrew J. Paprocki Registration No. 60,308

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
Group Art Unit 2663

In re

Patent Application of

Robert F. Dillon *et al.*

Application No. 16/160,230

Confirmation No.: 8509

Filed: October 15, 2018

Examiner: Vikkram Bali

"SCANNING SEQUENCE FOR AN INTRA-ORAL IMAGING SYSTEM"

Atty. Docket No. 208764-9006-US02

COMMENTS ON STATEMENT OF REASONS FOR ALLOWANCE UNDER 37 C.F.R. 1.104(e)

In the Reasons for Allowance accompanying the first Notice of Allowance dated September 22, 2021, the Examiner indicated that the prior art fails to disclose or suggest the combination of features set forth in the allowed claims, and recites one or more elements in support of this conclusion. Applicant respectfully submits that the Reasons for Allowance set forth only some of the features and elements of the claims, and that the reasons presented represent only some of the reasons why some of the claims are allowable. Also, the dependent claims include additional allowable subject matter.

Respectfully submitted,

/andrew.j.paprocki/

Andrew J. Paprocki
Reg. No. 60,308

Michael Best & Friedrich LLP
790 N. Water Street, Ste. 2500
Milwaukee, Wisconsin 53202

Electronic Patent Application Fee Transmittal

Application Number:	16160230
Filing Date:	15-Oct-2018
Title of Invention:	SCANNING SEQUENCE FOR AN INTRA-ORAL IMAGING SYSTEM
First Named Inventor/Applicant Name:	Robert F. Dillon
Filer:	Andrew J. Paprocki/Susan Kim
Attorney Docket Number:	208764-9006-US02

Filed as Large Entity

Filing Fees for Utility under 35 USC 111(a)

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
Pages:				
Claims:				
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				
UTILITY APPL ISSUE FEE	1501	1	1200	1200

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Extension-of-Time:				
Miscellaneous:				
			Total in USD ($)	**1200**

Electronic Acknowledgement Receipt

EFS ID:	44580518
Application Number:	16160230
International Application Number:	
Confirmation Number:	8509
Title of Invention:	SCANNING SEQUENCE FOR AN INTRA-ORAL IMAGING SYSTEM
First Named Inventor/Applicant Name:	Robert F. Dillon
Customer Number:	129916
Filer:	Andrew J. Paprocki/Susan Kim
Filer Authorized By:	Andrew J. Paprocki
Attorney Docket Number:	208764-9006-US02
Receipt Date:	21-DEC-2021
Filing Date:	15-OCT-2018
Time Stamp:	17:48:56
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	CARD
Payment was successfully received in RAM	$1200
RAM confirmation Number	E2021BKH49202012
Deposit Account	133080
Authorized User	Susan Kim

The Director of the USPTO is hereby authorized to charge indicated fees and credit any overpayment as follows:

37 CFR 1.21 (Miscellaneous fees and charges)

37 CFR 1.20 (Post Issuance fees)

37 CFR 1.19 (Document supply fees)

37 CFR 1.17 (Patent application and reexamination processing fees)

37 CFR 1.16 (National application filing, search, and examination fees)

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Issue Fee Payment (PTO-85B)	208764-9006-US02-IFT.pdf	120320 9f547ca6f080a14bd451d172f683dbba6c71d539	no	1
Warnings:					
Information:					
2	Post Allowance Communication - Incoming	208764-9006-US02-Comments.pdf	90055 efc51480414c2826ccf111fe398845ff475bd466	no	1
Warnings:					
Information:					
3	Fee Worksheet (SB06)	fee-info.pdf	38340 f613fc876a0592e8b89e61fca098452246d762f6	no	2
Warnings:					
Information:					
		Total Files Size (in bytes):	248715		

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

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United States Patent and Trademark Office
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www.uspto.gov

NOTICE OF ALLOWANCE AND FEE(S) DUE

129916 7590 09/22/2021
Michael Best & Friedrich LLP (DITC)
790 N WATER ST
SUITE 2500
MILWAUKEE, WI 53202

EXAMINER	
BALI, VIKKRAM	
ART UNIT	PAPER NUMBER
2663	

DATE MAILED: 09/22/2021

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
16/160,230	10/15/2018	Robert F. Dillon	208764-9006-US02	8509

TITLE OF INVENTION: SCANNING SEQUENCE FOR AN INTRA-ORAL IMAGING SYSTEM

APPLN. TYPE	ENTITY STATUS	ISSUE FEE DUE	PUBLICATION FEE DUE	PREV. PAID ISSUE FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	UNDISCOUNTED	$1200	$0.00	$0.00	$1200	12/22/2021

THE APPLICATION IDENTIFIED ABOVE HAS BEEN EXAMINED AND IS ALLOWED FOR ISSUANCE AS A PATENT. PROSECUTION ON THE MERITS IS CLOSED. THIS NOTICE OF ALLOWANCE IS NOT A GRANT OF PATENT RIGHTS. THIS APPLICATION IS SUBJECT TO WITHDRAWAL FROM ISSUE AT THE INITIATIVE OF THE OFFICE OR UPON PETITION BY THE APPLICANT. SEE 37 CFR 1.313 AND MPEP 1308.

THE ISSUE FEE AND PUBLICATION FEE (IF REQUIRED) MUST BE PAID WITHIN THREE MONTHS FROM THE MAILING DATE OF THIS NOTICE OR THIS APPLICATION SHALL BE REGARDED AS ABANDONED. THIS STATUTORY PERIOD CANNOT BE EXTENDED. SEE 35 U.S.C. 151. THE ISSUE FEE DUE INDICATED ABOVE DOES NOT REFLECT A CREDIT FOR ANY PREVIOUSLY PAID ISSUE FEE IN THIS APPLICATION. IF AN ISSUE FEE HAS PREVIOUSLY BEEN PAID IN THIS APPLICATION (AS SHOWN ABOVE), THE RETURN OF PART B OF THIS FORM WILL BE CONSIDERED A REQUEST TO REAPPLY THE PREVIOUSLY PAID ISSUE FEE TOWARD THE ISSUE FEE NOW DUE.

HOW TO REPLY TO THIS NOTICE:

I. Review the ENTITY STATUS shown above. If the ENTITY STATUS is shown as SMALL or MICRO, verify whether entitlement to that entity status still applies.

If the ENTITY STATUS is the same as shown above, pay the TOTAL FEE(S) DUE shown above.

If the ENTITY STATUS is changed from that shown above, on PART B - FEE(S) TRANSMITTAL, complete section number 5 titled "Change in Entity Status (from status indicated above)".

For purposes of this notice, small entity fees are 1/2 the amount of undiscounted fees, and micro entity fees are 1/2 the amount of small entity fees.

II. PART B - FEE(S) TRANSMITTAL, or its equivalent, must be completed and returned to the United States Patent and Trademark Office (USPTO) with your ISSUE FEE and PUBLICATION FEE (if required). If you are charging the fee(s) to your deposit account, section "4b" of Part B - Fee(s) Transmittal should be completed and an extra copy of the form should be submitted. If an equivalent of Part B is filed, a request to reapply a previously paid issue fee must be clearly made, and delays in processing may occur due to the difficulty in recognizing the paper as an equivalent of Part B.

III. All communications regarding this application must give the application number. Please direct all communications prior to issuance to Mail Stop ISSUE FEE unless advised to the contrary.

IMPORTANT REMINDER: Maintenance fees are due in utility patents issuing on applications filed on or after Dec. 12, 1980. It is patentee's responsibility to ensure timely payment of maintenance fees when due. More information is available at www.uspto.gov/PatentMaintenanceFees.

PART B - FEE(S) TRANSMITTAL

Complete and send this form, together with applicable fee(s), by mail or fax, or via EFS-Web.

By mail, send to: Mail Stop ISSUE FEE
Commissioner for Patents
P.O. Box 1450
Alexandria, Virginia 22313-1450

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CURRENT CORRESPONDENCE ADDRESS (Note: Use Block 1 for any change of address)

129916 7590 09/22/2021
Michael Best & Friedrich LLP (DITC)
790 N WATER ST
SUITE 2500
MILWAUKEE, WI 53202

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Certificate of Mailing or Transmission

I hereby certify that this Fee(s) Transmittal is being deposited with the United States Postal Service with sufficient postage for first class mail in an envelope addressed to the Mail Stop ISSUE FEE address above, or being transmitted to the USPTO via EFS-Web or by facsimile to (571) 273-2885, on the date below.

(Typed or printed name)
(Signature)
(Date)

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
16/160,230	10/15/2018	Robert F. Dillon	208764-9006-US02	8509

TITLE OF INVENTION: SCANNING SEQUENCE FOR AN INTRA-ORAL IMAGING SYSTEM

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nonprovisional	UNDISCOUNTED	$1200	$0.00	$0.00	$1200	12/22/2021

EXAMINER	ART UNIT	CLASS-SUBCLASS
BALI, VIKKRAM	2663	382-128000

1. Change of correspondence address or indication of "Fee Address" (37 CFR 1.363).

❑ Change of correspondence address (or Change of Correspondence Address form PTO/SB/122) attached.

❑ "Fee Address" indication (or "Fee Address" Indication form PTO/SB/47; Rev 03-09 or more recent) attached. **Use of a Customer Number is required.**

2. For printing on the patent front page, list
(1) The names of up to 3 registered patent attorneys or agents OR, alternatively,
(2) The name of a single firm (having as a member a registered attorney or agent) and the names of up to 2 registered patent attorneys or agents. If no name is listed, no name will be printed.

1 _____
2 _____
3 _____

3. ASSIGNEE NAME AND RESIDENCE DATA TO BE PRINTED ON THE PATENT (print or type)

PLEASE NOTE: Unless an assignee is identified below, no assignee data will appear on the patent. If an assignee is identified below, the document must have been previously recorded, or filed for recordation, as set forth in 37 CFR 3.11 and 37 CFR 3.81(a). Completion of this form is NOT a substitute for filing an assignment.

(A) NAME OF ASSIGNEE (B) RESIDENCE: (CITY and STATE OR COUNTRY)

Please check the appropriate assignee category or categories (will not be printed on the patent) : ❑ Individual ❑ Corporation or other private group entity ❑ Government

4a. Fees submitted: ❑ Issue Fee ❑ Publication Fee (if required) ❑ Advance Order - # of Copies _____

4b. Method of Payment: *(Please first reapply any previously paid fee shown above)*

❑ Electronic Payment via EFS-Web ❑ Enclosed check ❑ Non-electronic payment by credit card (Attach form PTO-2038)

❑ The Director is hereby authorized to charge the required fee(s), any deficiency, or credit any overpayment to Deposit Account No. _____

5. **Change in Entity Status** (from status indicated above)

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❑ Applicant asserting small entity status. See 37 CFR 1.27

❑ Applicant changing to regular undiscounted fee status.

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NOTE: Checking this box will be taken to be a notification of loss of entitlement to small or micro entity status, as applicable.

NOTE: This form must be signed in accordance with 37 CFR 1.31 and 1.33. See 37 CFR 1.4 for signature requirements and certifications.

Authorized Signature _____ Date _____

Typed or printed name _____ Registration No. _____

UNITED STATES PATENT AND TRADEMARK OFFICE

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
16/160,230	10/15/2018	Robert F. Dillon	208764-9006-US02	8509

129916 7590 09/22/2021

Michael Best & Friedrich LLP (DITC)
790 N WATER ST
SUITE 2500
MILWAUKEE, WI 53202

EXAMINER	
BALI, VIKKRAM	
ART UNIT	PAPER NUMBER
2663	

DATE MAILED: 09/22/2021

Determination of Patent Term Adjustment under 35 U.S.C. 154 (b)
(Applications filed on or after May 29, 2000)

The Office has discontinued providing a Patent Term Adjustment (PTA) calculation with the Notice of Allowance.

Section 1(h)(2) of the AIA Technical Corrections Act amended 35 U.S.C. 154(b)(3)(B)(i) to eliminate the requirement that the Office provide a patent term adjustment determination with the notice of allowance. See Revisions to Patent Term Adjustment, 78 Fed. Reg. 19416, 19417 (Apr. 1, 2013). Therefore, the Office is no longer providing an initial patent term adjustment determination with the notice of allowance. The Office will continue to provide a patent term adjustment determination with the Issue Notification Letter that is mailed to applicant approximately three weeks prior to the issue date of the patent, and will include the patent term adjustment on the patent. Any request for reconsideration of the patent term adjustment determination (or reinstatement of patent term adjustment) should follow the process outlined in 37 CFR 1.705.

Any questions regarding the Patent Term Extension or Adjustment determination should be directed to the Office of Patent Legal Administration at (571)-272-7702. Questions relating to issue and publication fee payments should be directed to the Customer Service Center of the Office of Patent Publication at 1-(888)-786-0101 or (571)-272-4200.

OMB Clearance and PRA Burden Statement for PTOL-85 Part B

The Paperwork Reduction Act (PRA) of 1995 requires Federal agencies to obtain Office of Management and Budget approval before requesting most types of information from the public. When OMB approves an agency request to collect information from the public, OMB (i) provides a valid OMB Control Number and expiration date for the agency to display on the instrument that will be used to collect the information and (ii) requires the agency to inform the public about the OMB Control Number's legal significance in accordance with 5 CFR 1320.5(b).

The information collected by PTOL-85 Part B is required by 37 CFR 1.311. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 30 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, Virginia 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, Virginia 22313-1450. Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

Privacy Act Statement

The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether disclosure of these records is required by the Freedom of Information Act.
2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.
3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.
4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).
5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.
6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).
7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.
8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspection or an issued patent.
9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

Notice of Allowability	Application No. 16/160,230	Applicant(s) Dillon et al.	
	Examiner VIKKRAM BALI	Art Unit 2663	AIA (FITF) Status No

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address--

All claims being allowable, PROSECUTION ON THE MERITS IS (OR REMAINS) CLOSED in this application. If not included herewith (or previously mailed), a Notice of Allowance (PTOL-85) or other appropriate communication will be mailed in due course. **THIS NOTICE OF ALLOWABILITY IS NOT A GRANT OF PATENT RIGHTS.** This application is subject to withdrawal from issue at the initiative of the Office or upon petition by the applicant. See 37 CFR 1.313 and MPEP 1308.

1. ☑ This communication is responsive to 9/7/2021.
   ☐ A declaration(s)/affidavit(s) under **37 CFR 1.130(b)** was/were filed on _____.

2. ☐ An election was made by the applicant in response to a restriction requirement set forth during the interview on _____; the restriction requirement and election have been incorporated into this action.

3. ☑ The allowed claim(s) is/are See Continuation Sheet . As a result of the allowed claim(s), you may be eligible to benefit from the **Patent Prosecution Highway** program at a participating intellectual property office for the corresponding application. For more information, please see **http://www.uspto.gov/patents/init_events/pph/index.jsp** or send an inquiry to **PPHfeedback@uspto.gov.**

4. ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

   Certified copies:

   a) ☐ All b) ☐ Some* c) ☐ None of the:

   1. ☐ Certified copies of the priority documents have been received.
   2. ☐ Certified copies of the priority documents have been received in Application No. _____ .
   3. ☐ Copies of the certified copies of the priority documents have been received in this national stage application from the International Bureau (PCT Rule 17.2(a)).

   * Certified copies not received: _____ .

Applicant has THREE MONTHS FROM THE "MAILING DATE" of this communication to file a reply complying with the requirements noted below. Failure to timely comply will result in ABANDONMENT of this application.
THIS THREE-MONTH PERIOD IS NOT EXTENDABLE.

5. ☐ CORRECTED DRAWINGS (as "replacement sheets") must be submitted.
   ☐ including changes required by the attached Examiner's Amendment / Comment or in the Office action of Paper No./Mail Date _____ .

   Identifying indicia such as the application number (see 37 CFR 1.84(c)) should be written on the drawings in the front (not the back) of each sheet. Replacement sheet(s) should be labeled as such in the header according to 37 CFR 1.121(d).

6. ☐ DEPOSIT OF and/or INFORMATION about the deposit of BIOLOGICAL MATERIAL must be submitted. Note the attached Examiner's comment regarding REQUIREMENT FOR THE DEPOSIT OF BIOLOGICAL MATERIAL.

Attachment(s)

1. ☐ Notice of References Cited (PTO-892)
2. ☐ Information Disclosure Statements (PTO/SB/08), Paper No./Mail Date _____.
3. ☐ Examiner's Comment Regarding Requirement for Deposit of Biological Material _____.
4. ☑ Interview Summary (PTO-413), Paper No./Mail Date. _____.
5. ☐ Examiner's Amendment/Comment
6. ☑ Examiner's Statement of Reasons for Allowance
7. ☐ Other _____.

/VIKKRAM BALI/
Primary Examiner, Art Unit 2663

Continuation of 3. The allowed claim(s) is/are: 2-7,11,13-21 and 26-29

DETAILED ACTION

Notice of Pre-AIA or AIA Status

The present application is being examined under the pre-AIA first to invent provisions.

All amendments to the claims as filled on 9/7/2021 have been entered and the action follows:

Allowable Subject Matter

Claims 2-7, 11, 13-21 and 26-29 are allowed.

The following is an examiner's statement of reasons for allowance: Claims are allowed because prior art taken alone or in combination with fails to disclose or teach generating an intra-oral scan of a dentition, the system includes a memory; and a processor coupled to the memory, wherein the processor is configured to: generate a contiguous scan of an occlusal surface of at least a part of one arch of the dentition, *remove image data of soft tissue from the contiguous scan of the occlusal surface based at least in part on an analysis of 3D data from the contiguous scan to distinguish between image data of the dentition and the image data of the soft tissue, wherein the soft tissue includes at least one selected from a group consisting of a tongue, a cheek, and a lip, and associate a scan of at least one additional surface to the contiguous scan of the occlusal surface by analyzing the scan data to identify a portion of the scan of the at least one additional surface that overlaps with a portion of the contiguous scan of the occlusal surface*, wherein the scan of the at least one additional surface includes a sequence of image frames including a plurality of image frames of the occlusal surface interspersed with a plurality of image frames of the at least one additional surface, and determining a position of the scan of the at least one additional surface relative to the scan of the occlusal surface based

on the identified overlapping portions, *wherein the processor is configured to generate the contiguous scan of the occlusal surface by capturing a plurality of partially overlapping image frames of the occlusal surface and stitching the overlapping image frames together to form a 3D model of the occlusal surface, wherein the processor is configured to remove the image data of the soft tissue from the contiguous scan by removing the image data of the soft tissue from the overlapping image frames used to generate the occlusal scan, and wherein the processor is further configured to update the contiguous scan of the occlusal surface by restitching the overlapping image frames together after removing the image data of the soft tissue to form an updated 3D model of the occlusal surface*, as claimed.

Any comments considered necessary by applicant must be submitted no later than the payment of the issue fee and, to avoid processing delays, should preferably accompany the issue fee. Such submissions should be clearly labeled "Comments on Statement of Reasons for Allowance."

Any inquiry concerning this communication or earlier communications from the examiner should be directed to VIKKRAM BALI whose telephone number is (571)272-7415. The examiner can normally be reached on Monday-Friday 7:00AM-3:00PM.

Examiner interviews are available via telephone, in-person, and video conferencing using a USPTO supplied web-based collaboration tool. To schedule an interview, applicant is encouraged to use the USPTO Automated Interview Request (AIR) at http://www.uspto.gov/interviewpractice.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Claire Wang can be reached on 571-270-1051. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see https://ppair-my.uspto.gov/pair/PrivatePair. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/VIKKRAM BALI/
Primary Examiner, Art Unit 2663

Examiner-Initiated Interview Summary	**Application No.** 16/160,230	**Applicant(s)** Dillon et al.		
	Examiner VIKKRAM BALI	**Art Unit** 2663	**AIA (First Inventor to File) Status** No	**Page** 1 of 1

All Participants (applicant, applicants representative, PTO personnel)	**Title**	**Type**
VIKKRAM BALI	Primary Examiner	Telephonic
Andrew Paprocki, Reg. # 60,308	Attorney of Record	

Date of Interview: 13 September 2021

Issues Discussed:

Other

Examiner called to discuss a double patenting in the application. Applicant representative agrees to file the Terminal Disclaimer.

/VIKKRAM BALI/ Primary Examiner, Art Unit 2663	

Applicant is reminded that a complete written statement as to the substance of the interview must be made of record in the application file. It is the applicants responsibility to provide the written statement, unless the interview was initiated by the Examiner and the Examiner has indicated that a written summary will be provided. See MPEP 713.04
Please further see:
MPEP 713.04
Title 37 Code of Federal Regulations (CFR) § 1.133 Interviews, paragraph (b)
37 CFR § 1.2 Business to be transacted in writing

Applicant recordation instructions: It is not necessary for applicant to provide a separate record of the substance of interview.

Examiner recordation instructions: Examiners must summarize the substance of any interview of record. A complete and proper recordation of the substance of an interview should include the items listed in MPEP 713.04 for complete and proper recordation including the identification of the general thrust of each argument or issue discussed, a general indication of any other pertinent matters discussed regarding patentability and the general results or outcome of the interview, to include an indication as to whether or not agreement was reached on the issues raised.

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	16/160,230	Dillon et al.
	Examiner	Art Unit
	VIKKRAM BALI	2663

CPC - Searched*		
Symbol	Date	Examiner

CPC Combination Sets - Searched*		
Symbol	Date	Examiner

US Classification - Searched*			
Class	Subclass	Date	Examiner

* See search history printout included with this form or the SEARCH NOTES box below to determine the scope of the search.

Search Notes		
Search Notes	Date	Examiner
Inventor name search	04/12/2019	vb
Limited text search in EAST and CPC - A61B$.CPC. A61C9$.CPC.	04/12/2019	vb
NPL search	04/12/2019	vb
Updated search	09/05/2019	vb
Updated seearch	09/25/2020	vb
NPL search terms - intra oral scan occlusal surface overlapping	09/25/2020	vb
Updated search	06/01/2021	vb
Updated search	09/14/2021	vb

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	16/160,230	Dillon et al.
	Examiner	Art Unit
	VIKKRAM BALI	2663

Interference Search			
US Class/CPC Symbol	US Subclass/CPC Group	Date	Examiner
	Limited text search of claim terms	09/14/2021	vb

Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	16/160,230	Dillon et al.
	Examiner	**Art Unit**
	VIKKRAM BALI	2663

CPC						
Symbol					**Type**	**Version**
A61C	/	9	/	0053	F	2013-01-01
A61B	/	1	/	24	I	2013-01-01
A61B	/	1	/	00009	I	2013-01-01
A61B	/	1	/	04	I	2013-01-01
A61B	/	1	/	0002	I	2013-01-01
A61C	/	9	/	006	I	2013-01-01
A61B	/	1	/	0005	I	2013-01-01

CPC Combination Sets							
Symbol					**Type**	**Set**	**Ranking**	**Version**
	/		/					

NONE		Total Claims Allowed:	
(Assistant Examiner)	(Date)	20	
/VIKKRAM BALI/ Primary Examiner, Art Unit 2663	14 September 2021	O.G. Print Claim(s)	O.G. Print Figure
(Primary Examiner)	(Date)	1	2

U.S. Patent and Trademark Office — Part of Paper No.: 20210914

Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	16/160,230	Dillon et al.
	Examiner	**Art Unit**
	VIKKRAM BALI	2663

INTERNATIONAL CLASSIFICATION					
CLAIMED					
A61C9/00	/	9	/	00	

NON-CLAIMED				
	/		/	

US ORIGINAL CLASSIFICATION	
CLASS	**SUBCLASS**

CROSS REFERENCES(S)						
CLASS	**SUBCLASS (ONE SUBCLASS PER BLOCK)**					

NONE (Assistant Examiner) (Date)	**Total Claims Allowed:** 20	
/VIKKRAM BALI/ Primary Examiner, Art Unit 2663 (Primary Examiner) 14 September 2021 (Date)	O.G. Print Claim(s) 1	O.G. Print Figure 2

Issue Classification	Application/Control No.	Applicant(s)/Patent Under Reexamination
	16/160,230	Dillon et al.
	Examiner	**Art Unit**
	VIKKRAM BALI	2663

☐ Claims renumbered in the same order as presented by applicant ☐ CPA ☐ T.D. ☐ R.1.47

CLAIMS

Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original	Final	Original
	1		10	17	19	9	28								
2	2	8	11	18	20	20	29								
3	3		12	19	21										
4	4	11	13		22										
5	5	14	14		23										
6	6	12	15		24										
7	7	13	16		25										
	8	15	17	1	26										
	9	16	18	10	27										

NONE		**Total Claims Allowed:**	
(Assistant Examiner)	(Date)	20	
/VIKKRAM BALI/ Primary Examiner, Art Unit 2663	14 September 2021	O.G. Print Claim(s)	O.G. Print Figure
(Primary Examiner)	(Date)	1	2

U.S. Patent and Trademark Office Part of Paper No.: 20210914

Index of Claims	Application/Control No.	Applicant(s)/Patent Under Reexamination
	16/160,230	Dillon et al.
	Examiner	Art Unit
	VIKKRAM BALI	2663

✓	Rejected	-	Cancelled	N	Non-Elected	A	Appeal
=	Allowed	÷	Restricted	I	Interference	O	Objected

CLAIMS

☐ Claims renumbered in the same order as presented by applicant ☐ CPA ☐ T.D. ☐ R.1.47

CLAIM		DATE								
Final	Original	04/12/2019	09/05/2019	05/21/2020	09/25/2020	06/01/2021	09/14/2021			
	1	✓	✓	÷	✓	✓	-			
2	2	✓	✓	÷	✓	✓	=			
3	3	✓	✓	÷	✓	✓	=			
4	4	✓	✓	÷	✓	✓	=			
5	5	✓	✓	÷	✓	✓	=			
6	6	✓	✓	÷	✓	✓	=			
7	7	✓	✓	÷	✓	✓	=			
	8	✓	✓	÷	-	-	-			
	9	✓	✓	÷	-	-	-			
	10	✓	✓	÷	-	-	-			
8	11	✓	✓	÷	✓	✓	=			
	12	✓	✓	÷	✓	✓	-			
11	13	✓	✓	÷	✓	✓	=			
14	14	✓	✓	÷	✓	✓	=			
12	15	✓	✓	÷	✓	✓	=			
13	16	✓	✓	÷	✓	✓	=			
15	17	✓	✓	÷	✓	✓	=			
16	18	✓	✓	÷	✓	✓	=			
17	19	✓	✓	÷	✓	✓	=			
18	20	✓	✓	÷	✓	✓	=			
19	21	✓	✓	÷	✓	✓	=			
	22	✓	-	-	-	-	-			
	23	✓	-	-	-	-	-			
	24	✓	-	-	-	-	-			
	25			÷	-	-	-			
1	26					O	=			
10	27					O	=			
9	28					✓	=			
20	29					✓	=			

EAST Search History

EAST Search History (Prior Art)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
S1	10	"9622834".pn. "9157733".pn. "20120062557".pn.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2017/06/12 11:07
S2	2	S1 and (oral and imag$4 and cavity and (wand handpiece) and occlusal)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2017/06/12 11:08
S3	150	(oral and imag$4 and cavity and (wand handpiece) and occlusal)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2017/06/12 11:13
S4	39	S3 and (lingual and labial)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2017/06/12 11:14
S5	719	ormco.asn.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2017/06/12 11:22
S6	2	S5 and (oral and imag$4 and cavity and (wand handpiece) and occlusal)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2017/06/12 11:22
S7	11	S5 and (oral and imag$4 and cavity and project$3)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2017/06/12 11:24

S8	5	S5 and (oral and imag$4 and cavity and project$3 and occlusal)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2017/06/12 11:28
S9	267	(dillon near robert).in.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2017/06/12 15:12
S10	218	(andreiko near craig).in.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2017/06/12 15:12
S11	12	(vesper near andrew).in.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2017/06/12 15:14
S12	178	(judell near neil).in.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2017/06/12 15:14
S13	41	(fillion near timothy).in.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2017/06/12 15:14
S14	598	S9 S10 S11 S12 S13	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2017/06/12 15:15
S15	13	S14 and (oral and imag$4 and cavity and project$3)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2017/06/12 15:18

S16	172,337	A61B$.CPC. A61C9$.CPC.	USPAT	OR	OFF	2017/06/12 16:05
S17	580	(oral and imag$4 and cavity and (wand handpiece scan$4) and occlusal and project$4 and (teeth tooth))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2017/06/12 16:06
S18	153	S16 and S17	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2017/06/12 16:07
S19	1	(oral and imag$4 and cavity and (wand handpiece scan$4) and occlusal and project$4 and (teeth tooth)).clm.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2017/06/12 16:07
S20	1	"8390822".pn.	USPAT	OR	OFF	2017/06/13 09:07
S21	0	S20 and (occlusal)	USPAT	OR	OFF	2017/06/13 09:10
S22	10	"9622834".pn. "9157733".pn. "20120062557".pn.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2017/06/13 09:15
S23	17	(backbone bone (back adj2 bone)) near occlusal	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2018/04/23 12:02
S24	2	("2014/0272774").URPN.	USPAT	OR	ON	2018/04/23 12:04
S25	1	(oral and imag$4 and cavity and (wand handpiece scan$4) and occlusal and project$4 and (teeth tooth)).clm.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2018/06/14 13:56
S26	17	s22s	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO;	OR	OFF	2018/06/14 13:56

			DERWENT; IBM_TDB			
S27	10	"9622834".pn. "9157733".pn. "20120062557".pn.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2018/06/14 13:56
S28	10	S27	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2018/06/14 13:56
S29	18	(backbone bone (back adj2 bone)) near occlusal	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2018/06/14 13:56
S30	18	S29	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2018/06/14 13:56
S31	186,805	A61B$.CPC. A61C9$.CPC.	USPAT	OR	OFF	2018/06/14 13:57
S32	675	(oral and imag$4 and cavity and (wand handpiece scan$4) and occlusal and project$4 and (teeth tooth))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2018/06/14 13:57
S33	187	S31 and S32	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2018/06/14 13:57
S34	187	S33	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2018/06/14 13:57
S35	199,441	A61B$.CPC. A61C9$.CPC.	USPAT	OR	OFF	2019/04/12 08:25

S36	739	(oral and imag$4 and cavity and (wand handpiece scan$4) and occlusal and project$4 and (teeth tooth))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2019/04/12 08:25
S37	211	S35 and S36	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2019/04/12 08:25
S38	307	(dillon near robert).in.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2019/04/12 08:26
S39	236	(andreiko near craig).in.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2019/04/12 08:26
S40	17	(vesper near andrew).in.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2019/04/12 08:26
S41	193	(judell near neil).in.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2019/04/12 08:26
S42	50	(fillion near timothy).in.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2019/04/12 08:26
S43	657	S38 S39 S40 S41 S42	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2019/04/12 08:26

S44	17	S43 and (oral and imag$4 and cavity and project$3)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2019/04/12 08:26
S45	8	("20040265770" | "20050058962" | "20120062557" | "20120129119" | "6402707" | "7717708" | "7905725" | "8390822").PN.	US-PGPUB; USPAT	OR	ON	2019/04/12 09:56
S46	4	"6648640".pn. "7286954".pn.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2019/04/12 13:27
S47	5	"20120062557".pn. "20040265770".pn.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2019/04/12 13:30
S48	0	S47 and (cheek lip tongue)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2019/04/12 13:30
S49	2	S47 and (color rigid$)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2019/04/12 13:31
S50	50	"s362" and (cheek lip tongue)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2019/04/12 14:16
S51	739	(oral and imag$4 and cavity and (wand handpiece scan$4) and occlusal and project$4 and (teeth tooth))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2019/04/12 14:16
S52	278	S51 and (cheek lip tongue)	US-PGPUB; USPAT; USOCR; FPRS;	OR	OFF	2019/04/12 14:16

			EPO; JPO; DERWENT; IBM_TDB			
S53	50	S51 and ((segment$4 differenc$4 substract$4) same (cheek lip tongue))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2019/04/12 14:17
S54	35	S51 and ((segment$4 differenc$4 substract$4) same (tongue))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2019/04/12 14:27
S55	489	((segment$4 differenc$4 substract$4) same (tongue) same image)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2019/04/12 15:56
S56	7	S51 and S55	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2019/04/12 15:56
S57	1,904	((segment$4 differenc$4 substract$4) same (cheek lip tongue) same image)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2019/04/12 15:58
S58	13	S51 and S57	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2019/04/12 15:59
S59	323	S57 and (occlusal teeth tooth dentit$3 jaw)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2019/04/12 16:14
S60	135	S57 same (occlusal teeth tooth dentit$3 jaw)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO;	OR	OFF	2019/04/12 16:14

			DERWENT; IBM_TDB			
S61	3	"20120062557".pn.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2019/09/05 07:55
S62	1	S61 and (labial lingual cloud noise)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2019/09/05 07:56
S63	8	("20040265770" | "20050058962" | "20120062557" | "20120129119" | "6402707" | "7717708" | "7905725" | "8390822").PN.	US-PGPUB; USPAT	OR	ON	2020/09/24 09:56
S64	8	S63	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2020/09/24 09:56
S65	6	S64 and occlusal	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2020/09/24 09:56
S66	4	"10098713".pn.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2020/09/24 11:50
S67	2	S66 and storage	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2020/09/24 11:50
S68	4	"10098713".pn.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2020/09/25 09:53

S69	1	S68 and coarse	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2020/09/25 09:53
S70	8	("20040265770" | "20050058962" | "20120062557" | "20120129119" | "6402707" | "7717708" | "7905725" | "8390822").PN.	US-PGPUB; USPAT	OR	ON	2020/09/25 09:55
S71	0	S70 and coarse	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2020/09/25 09:55
S72	7	S70 and (match$3 compar$4)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2020/09/25 09:55
S73	2,389	((segment$4 differenc$4 substract$4) same (cheek lip tongue) same image)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2021/06/01 17:09
S74	421	S73 and (occlusal teeth tooth dentit$3 jaw)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2021/06/01 17:09
S75	350	(dillon near robert).in.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2021/09/14 10:41
S76	246	(andreiko near craig).in.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2021/09/14 10:41
S77	17	(vesper near andrew).in.	US-PGPUB; USPAT; USOCR; FPRS;	OR	OFF	2021/09/14 10:41

			EPO; JPO; DERWENT; IBM_TDB			
S78	209	(judell near neil).in.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2021/09/14 10:41
S79	53	(fillion near timothy).in.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2021/09/14 10:41
S80	714	S75 S76 S77 S78 S79	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2021/09/14 10:41
S81	816	ormco.asn.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2021/09/14 10:41
S82	2,458	((segment$4 differenc$4 substract$4) same (cheek lip tongue) same image)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2021/09/14 10:42
S83	186	S82 same (occlusal teeth tooth dentit$3 jaw)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2021/09/14 10:42
S84	1,928,594	A61B$.CPC. A61C9$.CPC.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2021/09/14 10:43
S85	0	(oral and scan$4 and intra and surface and soft and tissue$2 and data and occlusal and overlap$4 and additional and partially and	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO;	OR	OFF	2021/09/14 10:47

		imag$3 and remov$4 and updat$4 and restitch$3).clm.	DERWENT; IBM_TDB			
S86	314	(oral and imag$4 and cavity and (wand handpiece) and occlusal)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2021/09/14 10:50
S87	59	S86 and (lingual and labial)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2021/09/14 10:50

EAST Search History (Interference)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
S88	0	(oral and scan$4 and intra and surface and soft and tissue$2 and data and occlusal and overlap$4 and additional and partially and imag$3 and remov$4 and updat$4 and restitch$3).clm.	US-PGPUB; USPAT	OR	OFF	2021/09/14 10:49

9/14/2021 11:26:29 AM
C:\Users\vbali\Documents\EAST\Workspaces\16160230.wsp

OK TO ENTER: /V.B/

09/14/2021

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
Group Art Unit 2663

In re

Patent Application of

Robert F. Dillon *et al.*

Application No. 16/160,230

Confirmation No.: 8509

Filed: October 15, 2018

Examiner: Vikkram Bali

"SCANNING SEQUENCE FOR AN INTRA-ORAL IMAGING SYSTEM"

Atty. Docket No. 208764-9006-US02

AMENDMENT AND RESPONSE TO OFFICE ACTION

Mail Stop Amendment
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Commissioner:

This communication is in response to the final Office action mailed June 4, 2021 and is filed within the three-month period for reply. Please charge or credit Deposit Account No. 13-3080 with any shortage or overpayment of the fees associated with this communication.

Amendments to the Claims begin on page 2 of this paper.

Remarks begin on page 10 of this paper.

IQQueryQuickExport-202109141529

Main Concept Text
==========
intra oral scan occlusal surface overlapping removing soft tissue

(No Concept Modifiers)
==========

(No Filters)
==========

Options
=======
De-dup: None
Cut-off: None
Sort: Relevance

Content: Non-Patent Literature (23)
==========
IEEE Xplore Publications: IEEE Periodicals
IEEE Xplore Publications: IEEE Conferences
IEEE Xplore Publications: IEEE Standards
IEEE Xplore Publications: IEEE Early Access
IEEE Xplore Publications: SMPTE Periodicals
IEEE Xplore Publications: SMPTE Conferences
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IP.com Prior Art Database: The IP.com Journal
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IP.com Prior Art Database: IBM TDB Archive
IP.com Prior Art Database: Legacy Journals
IP.com Prior Art Database: Software Patent Institute
OnePetro.org: Periodicals at OnePetro.org
OnePetro.org: Conferences at OnePetro.org
Other Literature: IBM Redbooks
Other Literature: PubMed Central
Other Literature: arXiv.org

Doc Code: DIST.E.FILE Document Description: Electronic Terminal Disclaimer - Filed	PTO/SB/26 U.S. Patent and Trademark Office Department of Commerce

Electronic Petition Request	**TERMINAL DISCLAIMER TO OBVIATE A DOUBLE PATENTING REJECTION OVER A "PRIOR" PATENT**
Application Number	16160230
Filing Date	15-Oct-2018
First Named Inventor	Robert Dillon
Attorney Docket Number	208764-9006-US02
Title of Invention	SCANNING SEQUENCE FOR AN INTRA-ORAL IMAGING SYSTEM

☒ Filing of terminal disclaimer does not obviate requirement for response under 37 CFR 1.111 to outstanding Office Action

☒ This electronic Terminal Disclaimer is not being used for a Joint Research Agreement.

Owner	Percent Interest
ORMCO CORPORATION	100%

The owner(s) with percent interest listed above in the instant application hereby disclaims, except as provided below, the terminal part of the statutory term of any patent granted on the instant application which would extend beyond the expiration date of the full statutory term of prior patent number(s)

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as the term of said prior patent is presently shortened by any terminal disclaimer. The owner hereby agrees that any patent so granted on the instant application shall be enforceable only for and during such period that it and the prior patent are commonly owned. This agreement runs with any patent granted on the instant application and is binding upon the grantee, its successors or assigns.

In making the above disclaimer, the owner does not disclaim the terminal part of the term of any patent granted on the instant application that would extend to the expiration date of the full statutory term of the prior patent, "as the term of said prior patent is presently shortened by any terminal disclaimer," in the event that said prior patent later:
- expires for failure to pay a maintenance fee;
- is held unenforceable;
- is found invalid by a court of competent jurisdiction;
- is statutorily disclaimed in whole or terminally disclaimed under 37 CFR 1.321;
- has all claims canceled by a reexamination certificate;
- is reissued; or
- is in any manner terminated prior to the expiration of its full statutory term as presently shortened by any terminal disclaimer.

◉ Terminal disclaimer fee under 37 CFR 1.20(d) is included with Electronic Terminal Disclaimer request.

○ I certify, in accordance with 37 CFR 1.4(d)(4), that the terminal disclaimer fee under 37 CFR 1.20(d) required for this terminal disclaimer has already been paid in the above-identified application.	
Applicant claims the following fee status: ○ Small Entity ○ Micro Entity ◉ Regular Undiscounted I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.	
THIS PORTION MUST BE COMPLETED BY THE SIGNATORY OR SIGNATORIES I certify, in accordance with 37 CFR 1.4(d)(4) that I am: ◉ An attorney or agent registered to practice before the Patent and Trademark Office who is of record in this application Registration Number 60308 ○ A sole inventor ○ A joint inventor; I certify that I am authorized to sign this submission on behalf of all of the inventors as evidenced by the power of attorney in the application ○ A joint inventor; all of whom are signing this request	
Signature	/andrew.j.paprocki/
Name	Andrew J. Paprocki

*Statement under 37 CFR 3.73(b) is required if terminal disclaimer is signed by the assignee (owner).
Form PTO/SB/96 may be used for making this certification. See MPEP § 324.

Electronic Patent Application Fee Transmittal

Application Number:	16160230
Filing Date:	15-Oct-2018
Title of Invention:	SCANNING SEQUENCE FOR AN INTRA-ORAL IMAGING SYSTEM
First Named Inventor/Applicant Name:	Robert F. Dillon
Filer:	Andrew J. Paprocki/Elizabeth Tressler
Attorney Docket Number:	208764-9006-US02

Filed as Large Entity

Filing Fees for Utility under 35 USC 111(a)

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
STATUTORY OR TERMINAL DISCLAIMER	1814	1	170	170
Pages:				
Claims:				
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Extension-of-Time:				
Miscellaneous:				
			Total in USD ($)	**170**

Doc Code: DISQ.E.FILE
Document Description: Electronic Terminal Disclaimer – Approved

Application No.: 16160230

Filing Date: 15-Oct-2018

Applicant/Patent under Reexamination: Dillon

Electronic Terminal Disclaimer filed on September 13, 2021

☒ APPROVED

This patent is subject to a terminal disclaimer

☐ DISAPPROVED

Approved/Disapproved by: Electronic Terminal Disclaimer automatically approved by EFS-Web

U.S. Patent and Trademark Office

Electronic Acknowledgement Receipt

EFS ID:	43746245
Application Number:	16160230
International Application Number:	
Confirmation Number:	8509
Title of Invention:	SCANNING SEQUENCE FOR AN INTRA-ORAL IMAGING SYSTEM
First Named Inventor/Applicant Name:	Robert F. Dillon
Customer Number:	129916
Filer:	Andrew J. Paprocki/Elizabeth Tressler
Filer Authorized By:	Andrew J. Paprocki
Attorney Docket Number:	208764-9006-US02
Receipt Date:	13-SEP-2021
Filing Date:	15-OCT-2018
Time Stamp:	13:56:43
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	CARD
Payment was successfully received in RAM	$170
RAM confirmation Number	E20219CD56380323
Deposit Account	133080
Authorized User	Elizabeth Tressler

The Director of the USPTO is hereby authorized to charge indicated fees and credit any overpayment as follows:

37 CFR 1.21 (Miscellaneous fees and charges)

37 CFR 1.20 (Post Issuance fees)

37 CFR 1.19 (Document supply fees)

37 CFR 1.17 (Patent application and reexamination processing fees)

37 CFR 1.16 (National application filing, search, and examination fees)

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Terminal Disclaimer-Filed (Electronic)	eTerminal-Disclaimer.pdf	41247 57555780f2f6fc82a2d0a43a32114b0afee28cf0	no	2
Warnings:					
Information:					
2	Fee Worksheet (SB06)	fee-info.pdf	38218 10ad812e4ab7aabda0d2735ec4636addd0e138c0	no	2
Warnings:					
Information:					
		Total Files Size (in bytes):	79465		

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New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
Group Art Unit 2663

In re

Patent Application of

Robert F. Dillon *et al.*

Application No. 16/160,230

Confirmation No.: 8509

Filed: October 15, 2018

Examiner: Vikkram Bali

"SCANNING SEQUENCE FOR AN INTRA-ORAL IMAGING SYSTEM"

Atty. Docket No. 208764-9006-US02

AMENDMENT AND RESPONSE TO OFFICE ACTION

Mail Stop Amendment
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Commissioner:

This communication is in response to the final Office action mailed June 4, 2021 and is filed within the three-month period for reply. Please charge or credit Deposit Account No. 13-3080 with any shortage or overpayment of the fees associated with this communication.

Amendments to the Claims begin on page 2 of this paper.

Remarks begin on page 10 of this paper.

AMENDMENTS TO THE CLAIMS:

This listing of claims will replace all prior versions, and listings, of claims in the application:

1. (Cancelled)

2. (Currently Amended) The system of claim 26 ~~claim 1~~, wherein the processor is further configured to associate a plurality of scans of additional surfaces to the contiguous scan of the occlusal surface, wherein the plurality of scans of the additional surfaces includes a plurality of scans of labial surfaces and a plurality of scans of lingual surfaces.

3. (Currently Amended) The system of claim 26 ~~claim 1~~, wherein the plurality of image frames of the occlusal surface from the scan of the at least one additional surface each overlap with the contiguous scan of the occlusal surface,

wherein the plurality of images frames of the at least on additional surface includes image frames of a labial or lingual surface, and

wherein the processor is configured to use the plurality of image frames of the occlusal surface that is included in the scan of the at least one additional surface to determine a position of the image frames of the labial or lingual surface relative to the contiguous scan of the occlusal surface.

4. (Previously Presented) The system of claim 2, wherein the occlusal surface is imaged prior to the plurality of labial and lingual surfaces, and wherein the processor is further configured to display in real-time a three-dimensional representation of the dentition as the plurality of labial and lingual surfaces are imaged.

5. (Previously Presented) The system of claim 4, wherein the processor is configured to display in real-time the three-dimensional representation of the dentition by performing a coarse matching by matching features as the plurality of labial and lingual surfaces are imaged, and

wherein the processor is further configured to generate a three-dimensional reconstruction of the dentition based on a point cloud alignment after the plurality of labial and lingual surfaces are all imaged.

6. (Currently Amended) The system of claim 26~~claim 1~~, wherein the processor is further configured to generate an occlusal backbone by matching selected frames of the contiguous scan of the occlusal surface that have an overlap based on an analysis of data.

7. (Previously Presented) The system of claim 6, wherein the processor is configured to detect the overlap based on noise characteristics of the data.

8-10. (Cancelled)

11. (Currently Amended) The system of claim 26~~claim 1~~, further comprising:

a projector that projects interferometric fringes on an occlusal surface of at least a part of one arch of the dentition primarily along an anterior-posterior direction; and

an imaging sensor that is used to view the interferometric fringes,

wherein the processor is further configured to generate the contiguous scan of the occlusal surface based on the interferometric fringes sensed by the imaging sensor.

12. (Cancelled)

13. (Currently Amended) The computer readable storage medium of claim 27~~claim 12~~, wherein the code, when executed by the processor, further causes the system to associate a plurality of scans of additional surfaces to the contiguous scan of the occlusal surface, wherein the plurality of scans of the additional surfaces includes a plurality of scans of labial surfaces and a plurality of scans of lingual surfaces.

14. (Currently Amended) The computer readable storage medium of claim 27~~claim 12~~, wherein the plurality of image frames of the occlusal surface from the scan of the at least one additional surface each overlap with the contiguous scan of the occlusal surface,

wherein the plurality of image frames of the at least one additional surface includes image frames of a labial or lingual surface, and

wherein the code, when executed by the processor, causes the system to use the plurality of image frames of the occlusal surface that is included in the scan of the at least one additional surface to determine a position of the image frames of the labial or lingual surface relative to the contiguous scan of the occlusal surface.

15. (Previously Presented) The computer readable storage medium of claim 13, wherein the occlusal surface is imaged prior to the plurality of labial and lingual surfaces, and wherein the code, when executed by the processor, causes the system to display in real-time a three-dimensional representation of the dentition as the plurality of labial and lingual surfaces are imaged.

16. (Previously Presented) The computer readable storage medium of claim 15, wherein the code, when executed by the processor, causes the system to display in real-time the three-dimensional representation of the dentition by performing a coarse matching by matching features as the plurality of labial and lingual surfaces are imaged, and

wherein the code, when executed by the processor, further causes the system to generate a three-dimensional reconstruction of the dentition based on a point cloud alignment after the plurality of labial and lingual surfaces are all imaged.

17. (Currently Amended) The computer readable storage medium of claim 27~~claim 12~~, wherein the code, when executed by the processor, further causes the system to generate an occlusal backbone by matching selected frames of the contiguous scan of the occlusal surface that have an overlap based on an analysis of data.

18. (Previously Presented) The computer readable storage medium of claim 17, wherein the code, when executed by the processor, further causes the system to detect the overlap based on noise characteristics of the data.

19. (Previously Presented) The computer readable storage medium of claim 17, wherein the occlusal backbone is a first occlusal backbone, and wherein the code, when executed by the processor, further causes the system to generate a second occlusal backbone that is more accurate than the first occlusal backbone by linking other frames that are different from the selected frames to the first occlusal backbone.

20. (Previously Presented) The computer readable storage medium of claim 19, wherein the code, when executed by the processor, causes the system to remove the image data of the

soft tissue from the contiguous scan of the occlusal surface by generating a third occlusal backbone by removing, from the second occlusal backbone, areas representing the soft tissue.

21. (Previously Presented) The computer readable storage medium of claim 20, wherein the code, when executed by the processor, causes the system to remove the image data of the soft tissue based at least in part on the analysis of 3D data from the contiguous scan by removing the image data of the soft tissue based at least in part on the analysis of the 3D data and at least one selected from a group consisting of a difference in color and a difference in rigidity properties.

22-25. (Cancelled)

26. (Currently Amended) ~~The~~ A system ~~of claim 1,~~ for generating an intra-oral scan of a dentition, the system comprising:

a memory; and

a processor coupled to the memory, wherein the processor is configured to:

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

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

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

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

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

determining a position of the scan of the at least one additional surface relative to the scan of the occlusal surface based on the identified overlapping portions,

wherein the processor is configured to generate the contiguous scan of the occlusal surface by capturing a plurality of partially overlapping image frames of the occlusal surface and stitching the overlapping image frames together to form a 3D model of the occlusal surface,

wherein the processor is configured to remove the image data of the soft tissue from the contiguous scan by removing the image data of the soft tissue from the overlapping image frames used to generate the occlusal scan, and

wherein the processor is further configured to update the contiguous scan of the occlusal surface by restitching the overlapping image frames together after removing the image data of the soft tissue to form an updated 3D model of the occlusal surface.

27. (Currently Amended) ~~The~~ A computer readable storage medium ~~of claim 12, wherein the code stored in the computer readable storage medium, when executed by the processor, causes the system to:~~ for generating an intra-oral scan of a dentition, wherein code stored in the computer readable storage medium, when executed by a processor, causes a system to:

generate ~~the~~ a contiguous scan of ~~the~~ an occlusal surface of at least a part of one arch of the dentition by capturing a plurality of partially overlapping image frames of the occlusal surface and stitching the overlapping image frames together to form a 3D model of the occlusal surface; ~~, and~~

remove ~~the~~ image data of ~~the~~ soft tissue ~~from the contiguous scan by removing the image data of the soft tissue~~ from the overlapping image frames used to generate the occlusal scan based at least in part on an analysis of 3D data from the contiguous scan to distinguish between image data of the dentition and the image data of the soft tissue, wherein the soft tissue includes at least one selected from a group consisting of a tongue, a cheek, and a lip;[[,]] ~~and~~

~~wherein the code stored in the computer readable storage medium, when executed by the processor, further cause the system to~~ update the contiguous scan of the occlusal surface by restitching the overlapping image frames together after removing the ~~after removing the~~ image data of the soft tissue to form an updated 3D model of the occlusal surface; and

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

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

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

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

28. (Currently Amended) The system of claim 26~~claim 1~~, wherein the processor is configured to remove the image data of soft tissue from the contiguous scan of the occlusal surface based at least in part on the analysis of 3D data from the contiguous scan by distinguishing between the image data of the dentition and the image data of the soft tissue based at least in part on a comparison of surface normals of 3D structures in the contiguous scan.

29. (Currently Amended) The computer readable storage medium of claim 27~~claim 12~~, wherein the code stored in the computer readable storage medium, when executed by the processor, cause the system to remove the image data of soft tissue from the contiguous scan of the occlusal surface based at least in part on the analysis of 3D data from the contiguous scan by distinguishing between the image data of the dentition and the image data of the soft tissue based at least in part on a comparison of surface normals of 3D structures in the contiguous scan.

REMARKS

By this Amendment, claims 1 and 12 have been cancelled and claims 2, 3, 6, 11, 13, 14, 17, and 26-29 have been amended. After entry of this Amendment, claims 2-7, 11, 13-21, and 26-29 remain pending.

In the Office action, the Examiner has confirmed that claims 26 and 27 recite allowable subject matter and would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims. Claims 26 and 27 have been amended into independent form including all of the limitations recited in independent claims 1 and 12, respectively. Accordingly, independent claims 26 and 27 are now in condition for allowance.

Claims 2-7, 11, & 28 and claims 13-21 & 29 depend from claims 26 and 27, respectively, and are allowable for the same reasons and also because they recite additional patentable subject matter.

Independent claims 1 and 12 have been cancelled and, therefore, the Examiner rejections of those claims is moot.

In view of the above, the Applicant respectfully requests entry of this Amendment and allowance of claims 2-7, 11, 13-21, and 26-29. The undersigned is available for telephone consultation at the number below during normal business hours.

Respectfully submitted,

/andrew.j.paprocki/

Andrew J. Paprocki
Reg. No. 60,308

File No. 208764-9006-US02
Michael Best & Friedrich LLP
790 N. Water Street, Ste. 2500
Milwaukee, Wisconsin 53202
414-225-4947

Electronic Acknowledgement Receipt

EFS ID:	43694214
Application Number:	16160230
International Application Number:	
Confirmation Number:	8509
Title of Invention:	SCANNING SEQUENCE FOR AN INTRA-ORAL IMAGING SYSTEM
First Named Inventor/Applicant Name:	Robert F. Dillon
Customer Number:	129916
Filer:	Andrew J. Paprocki/Elizabeth Tressler
Filer Authorized By:	Andrew J. Paprocki
Attorney Docket Number:	208764-9006-US02
Receipt Date:	07-SEP-2021
Filing Date:	15-OCT-2018
Time Stamp:	14:41:02
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	no

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1		208764-9006-US02_Response_filed_9-7-2021.pdf	112511 4d4cdc25b955ef2412e751192c03fc81f1311d9e	yes	10

	Multipart Description/PDF files in .zip description		
	Document Description	**Start**	**End**
	Response After Final Action	1	1
	Claims	2	9
	Applicant Arguments/Remarks Made in an Amendment	10	10
Warnings:			
Information:			
	Total Files Size (in bytes):	112511	

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

PTO/SB/06 (09-11)
Approved for use through 1/31/2014. OMB 0651-0032
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
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PATENT APPLICATION FEE DETERMINATION RECORD Substitute for Form PTO-875	Application or Docket Number 16/160,230	Filing Date 10/15/2018	☐ To be Mailed

ENTITY: ☑ LARGE ☐ SMALL ☐ MICRO

APPLICATION AS FILED - PART I

FOR	(Column 1) NUMBER FILED	(Column 2) NUMBER EXTRA		RATE ($)	FEE ($)
☐ BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A		N/A	
☐ SEARCH FEE (37 CFR 1.16(k), (i), or (m))	N/A	N/A		N/A	
☐ EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A		N/A	
TOTAL CLAIMS (37 CFR 1.16(i))	minus 20 =	*		x $100 =	
INDEPENDENT CLAIMS (37 CFR 1.16(h))	minus 3 =	*		x $460 =	
☐ APPLICATION SIZE FEE (37 CFR 1.16(s))	If the specification and drawings exceed 100 sheets of paper, the application size fee due is $310 ($155 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).				
☐ MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))					
* If the difference in column 1 is less than zero, enter "0" in column 2.				TOTAL	

APPLICATION AS AMENDED - PART II

		(Column 1)		(Column 2)	(Column 3)			
AMENDMENT	09/07/2021	CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA		RATE ($)	ADDITIONAL FEE ($)
	Total (37 CFR 1.16(i))	* 20	Minus	** 22	= 0		x $100 =	0
	Independent (37 CFR 1.16(h))	* 3	Minus	*** 3	= 0		x $480 =	0
	☐ Application Size Fee (37 CFR 1.16(s))							
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							
							TOTAL ADD'L FEE	0

		(Column 1)		(Column 2)	(Column 3)			
AMENDMENT		CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA		RATE ($)	ADDITIONAL FEE ($)
	Total (37 CFR 1.16(i))	*	Minus	**	=		x $0 =	
	Independent (37 CFR 1.16(h))	*	Minus	***	=		x $0 =	
	☐ Application Size Fee (37 CFR 1.16(s))							
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							
							TOTAL ADD'L FEE	

* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.	LIE
** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20".	/ALLYSON PURNELL/
*** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3".	
The "Highest Number Previously Paid For" (Total or Independent) is the highest number found in the appropriate box in column 1.	

This collection of information is required by 37 CFR 1.16. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
16/160,230	10/15/2018	Robert F. Dillon	208764-9006-US02	8509

129916 7590 06/04/2021

Michael Best & Friedrich LLP (DITC)
790 N WATER ST
SUITE 2500
MILWAUKEE, WI 53202

EXAMINER	
BALI, VIKKRAM	

ART UNIT	PAPER NUMBER
2663	

NOTIFICATION DATE	DELIVERY MODE
06/04/2021	ELECTRONIC

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

mkeipdocket@michaelbest.com

Office Action Summary	Application No. 16/160,230	Applicant(s) Dillon et al.	
	Examiner VIKKRAM BALI	Art Unit 2663	AIA (FITF) Status No

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTHS FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☑ Responsive to communication(s) filed on 3/29/2021.

☐ A declaration(s)/affidavit(s) under **37 CFR 1.130(b)** was/were filed on _____.

2a)☑ This action is **FINAL.** 2b) ☐ This action is non-final.

3)☐ An election was made by the applicant in response to a restriction requirement set forth during the interview on _____; the restriction requirement and election have been incorporated into this action.

4)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims*

5) ☑ Claim(s) 1-7,11-21 and 26-29 is/are pending in the application.

5a) Of the above claim(s) _____ is/are withdrawn from consideration.

6) ☐ Claim(s) _____ is/are allowed.

7) ☑ Claim(s) 1-7,11-21 and 28-29 is/are rejected.

8) ☑ Claim(s) 26-27 is/are objected to.

9) ☐ Claim(s) _____ are subject to restriction and/or election requirement

* If any claims have been determined allowable, you may be eligible to benefit from the **Patent Prosecution Highway** program at a participating intellectual property office for the corresponding application. For more information, please see http://www.uspto.gov/patents/init_events/pph/index.jsp or send an inquiry to **PPHfeedback@uspto.gov.**

Application Papers

10)☐ The specification is objected to by the Examiner.

11)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

Certified copies:

a)☐ All b)☐ Some** c)☐ None of the:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

** See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)

2) ☐ Information Disclosure Statement(s) (PTO/SB/08a and/or PTO/SB/08b) Paper No(s)/Mail Date _____.

3) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date _____.

4) ☐ Other: _____.

DETAILED ACTION

Notice of Pre-AIA or AIA Status

1. The present application is being examined under the pre-AIA first to invent provisions.

Response to Arguments

Applicant's arguments filed have been fully considered but they are not persuasive.

Applicant argues "In rejecting claims 20 and 21, the Examiner conceded that Chapoulaud and Dillon both fail to teach or suggest removing image data representing tongue, cheek, or lips from the contiguous scan (i.e. from the constructed "occlusal backbone"). Instead, the Examiner argues that Deichmann teaches segmenting image data corresponding to the lip and image data corresponding to the teeth by using a color difference (Office action, page 8, citing Deichmann, para. [0101]). However, Deichmann does not teach or suggest differentiating between image data of soft tissues (e.g., tongue, cheek, and/or lip) and image data of teeth based on an analysis of 3D data (e.g., shape, contour, surface normals, etc.) as required by independent claims 1 and 12. Therefore, Deichmann does not cure the deficiencies of Chapoulaud and Dillon with respect to the subject matter defined by independent claims 1 and 12 as amended.", (see Remarks page 10 last paragraph).

Examiner respectfully disagrees, Deichmann in paragraph 0101, ...segmenting the lips and the teeth.....performed automatically by means of well-known image processing algorithms.....by means of analyzing the color difference...., and as shown in figure 5f and 5g. As required by the limitation as claimed in amended claims 1 and 12.

Therefore, the limitations are taught in the reference.

Claim Rejections - 35 USC § 103

2. The following is a quotation of pre-AIA 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

3. Claims 1-7, 11-21, 28 and 29 are rejected under pre-AIA 35 U.S.C. 103(a) as being unpatentable over Chapoulaud et al (US 2004/0265770) in view of Dillon et al (US 2012/0062557) and Diechmann et al (US Pub. 2013/0218530).

With respect to claim 1, Chapoulaud discloses generating a scan of a dentition, the system comprising (see Abstract):

a memory; a processor coupled to the memory, wherein the processor is configured to (see figure 1):

generate a contiguous scan of an occlusal surface of at least a part of one arch of the dentition, (see figure 1, 3, 3A, 3B, and 4, and paragraph 0071) as claimed.

However, he fails to disclose associate a scan of at least one additional surface to the contiguous scan of the occlusal surface by analyzing the scan data to identify a portion of the scan of the at least one additional surface that overlaps with a portion of the contiguous scan of the occlusal surface, wherein the scan of the at least one additional surface includes a sequence of image frames including a plurality of image frames of the occlusal surface interspersed with a plurality of image frames of the at least one additional surface, and determining a position of the scan of the at least one

additional surface relative to the scan of the occlusal surface based on the identified overlapping portions, as claimed.

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

Dillon in the same field of art to generate an intra-oral scan of a dentition (see Abstract) teaches associate a scan of at least one additional surface to the contiguous scan of the occlusal surface by analyzing the scan data to identify a portion of the scan of the at least one additional surface that overlaps with a portion of the contiguous scan of the occlusal surface, wherein the scan of the at least one additional surface includes a sequence of image frames including a plurality of image frames of the occlusal surface interspersed with a plurality of image frames of the at least one additional surface, and determining a position of the scan of the at least one additional surface relative to the scan of the occlusal surface based on the identified overlapping portions, (see figures 4A-4C, and paragraphs 0055-0056, also paragraph 0039 teaches illuminating and scanning occlusal surface of a patient using a scanning device 12 and then in paragraph 0040 it discloses that if needed a clinician can move the scanning device to another surface of second region to obtain more images of the occlusal surface) as claimed.

Therefore, it would have been obvious to one ordinary skilled in the art at the time of invention to combine the two references as they are analogous because they

are solving similar problem of intra oral scanning. The teachings of Dillon of data display in real time using the 3D display can be incorporated into Chapoulaud's system for the ease of the system.

And, Deichmann in the same field of art teaches remove image data of soft tissue from the contiguous scan of the occlusal surface based at least in part on an analysis of 3D data from the contiguous scan to distinguish between image data of the dentition and the image data of the soft tissue, wherein the soft tissue includes at least one selected from a group consisting of a tongue, a cheek, and a lip, (see paragraph 0101, ….segmenting the lips and the teeth……performed automatically by means of well-known image processing algorithms…..by means of analyzing the color difference…., and as shown in figure 5f and 5g), as claimed.

Therefore, it would have been obvious to one ordinary skilled in the art at the time of invention to combine the references as they are analogous because they are solving similar problem of intra oral scanning. The teachings of Deichmann of segmenting the images to get the clear image of teeth can be incorporated into Chapoulaud's and Dillon system to yield the clear imagery for motivation.

With respect to claim 2, combination of Chapoulaud, Dillon and Diechmann further discloses the processor is further configured to associate a plurality of scans of additional surfaces to the contiguous scan of the occlusal surface, wherein the plurality of scans of the additional surfaces includes a plurality of scans of labial surfaces and a plurality of scans of lingual surfaces, (see Chapoulaud figure 4, and paragraph 0071) as claimed.

With respect to claim 3 combination of Chapoulaud, Dillon and Diechmann further discloses wherein the plurality of image frames of the occlusal surface from the scan of the at least one additional surface each overlap with the contiguous scan of the occlusal surface, wherein the plurality of images frames of the at least on additional surface includes image frames of a labial or lingual surface, and wherein the processor is configured to use the plurality of image frames of the occlusal surface that is included in the scan of the at least one additional surface to determine a position of the image frames of the labial or lingual surface relative to the contiguous scan of the occlusal surface., (see Chapoulaud figure 4 and paragraph 0071) as claimed.

With respect to claim 4, combination of Chapoulaud, Dillon and Diechmann further discloses wherein the occlusal surface is imaged prior to the plurality of labial and lingual surfaces, and wherein the processor is further configured to display in real-time a three-dimensional representation of the dentition as the plurality of labial and lingual surfaces are imaged, (see Chapoulaud figure 4) as claimed.

With respect to claim 5, combination of Chapoulaud, Dillon and Diechmann further discloses wherein the processor is configured to display in real-time the three-dimensional representation of the dentition by performing a coarse matching by matching features as the plurality of labial and lingual surfaces are imaged, and wherein the processor is further configured to generate a three-dimensional reconstruction of the dentition based on a point cloud alignment after the plurality of labial and lingual

surfaces are all imaged, (see Dillon in paragraph 0046, states that the 3D representation is in point cloud, and in paragraph 0043, the figure 4B, is the display of the 3D point cloud, and figure 4B is the display of two scans put together i.e. aligned; also paragraph 0022 states the current video image "additional surface" is match to the previous or displayed data), as claimed.

With respect to claim 6, combination of Chapoulaud, Dillon and Diechmann further discloses wherein the processor is further configured to generate an occlusal backbone by matching selected frames of the contiguous scan of the occlusal surface that have an overlap based on an analysis of data, (see Chapoulaud figure 3A, 3B, and 4, and paragraph 0071) as claimed.

With respect to claim 7, combination of Chapoulaud, Dillon and Diechmann further discloses wherein the processor is configured to detect the overlap based on noise characteristics of the data, (see Dillon paragraph 0037, right hand column last 6 lines, checking if the two displays are similar "noise characteristics") as claimed.

With respect to claim 11, combination of Chapoulaud, Dillon and Diechmann further discloses a projector that projects interferometric fringes on an occlusal surface of at least a part of one arch of the dentition primarily along an anterior-posterior direction; and an imaging sensor that is used to view the interferometric fringes, wherein the processor is further configured to generate the contiguous scan of the occlusal

surface based on the interferometric fringes sensed by the imaging sensor, as claimed, (see Dillon figure 2, numerical 22, and paragraph 0028), as claimed.

Claims 12-15 and 17, are for the same reason as set forth in the rejections for claims 1-4 and 6, because claims 12-15 and 17 are claiming subject matter similar to the claimed subject in claims 1-4 and 6.

Claims 16 and 18, are for the same reason as set forth in the rejections for claims 5 and 7, because claims 16 and 18 are claiming subject matter similar to the claimed subject in claims 5 and 7.

With respect to claim 19, combination of Chapoulaud, Dillon and Diechmann further discloses wherein the occlusal backbone is a first occlusal backbone, and wherein the code, when executed by the processor, further causes the system to generate a second occlusal backbone that is more accurate than the first occlusal backbone by linking other frames that are different from the selected frames to the first occlusal backbone., (see Chapoulaud paragraph 0071, low and high resolution imaging is read as first and second occlusal backbone imaging) as claimed.

With respect to claim 20, combination of Chapoulaud, Dillon and Diechmann further discloses wherein the code, when executed by the processor, causes the system to remove the image data of the soft tissue from the contiguous scan of the occlusal surface by generating a third occlusal backbone by removing, from the second occlusal

backbone, areas representing the soft tissue, (see Diechmann figure 5f and 5g there is no tongue is not shown "soft tissue") as claimed.

With respect to claim 21, combination of Chapoulaud, Dillon and Diechmann further discloses wherein the code, when executed by the processor, causes the system to remove the image data of the soft tissue based at least in part on the analysis of 3D data from the contiguous scan by removing the image data of the soft tissue based at least in part on the analysis of the 3D data and at least one selected from a group consisting of a difference in color and a difference in rigidity properties (see Diechmann paragraph 0101, ….segmenting the lips and the teeth "rigidity" ……performed automatically by means of well-known image processing algorithms…..by means of analyzing the color difference…., and as shown in figure 5f and 5g), as claimed.

With respect to claim 28, combination of Chapoulaud, Dillon and Diechmann further discloses wherein the processor is configured to remove the image data of soft tissue from the contiguous scan of the occlusal surface based at least in part on the analysis of 3D data from the contiguous scan by distinguishing between the image data of the dentition and the image data of the soft tissue based at least in part on a comparison of surface normals of 3D structures in the contiguous scan, (see Diechmann paragraph 0101, ….segmenting the lips and the teeth ……performed automatically by means of well-known image processing algorithms…..by means of analyzing the color difference…., and as shown in figure 5f and 5g), as claimed.

Claim 29 is for the same reason as set forth in the rejections for claim 28, because claim 29 is claiming subject matter similar to the claimed subject in claim 28.

Allowable Subject Matter

Claims 26 and 27 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

Conclusion

THIS ACTION IS MADE FINAL. Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to VIKKRAM BALI whose telephone number is (571)272-7415. The examiner can normally be reached on Monday-Friday 7:00AM-3:00PM.

Examiner interviews are available via telephone, in-person, and video conferencing using a USPTO supplied web-based collaboration tool. To schedule an interview, applicant is encouraged to use the USPTO Automated Interview Request (AIR) at http://www.uspto.gov/interviewpractice.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Claire Wang can be reached on 571-270-1051. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see https://ppair-my.uspto.gov/pair/PrivatePair. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/VIKKRAM BALI/
Primary Examiner, Art Unit 2663

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	16/160,230	Dillon et al.
	Examiner	Art Unit
	VIKKRAM BALI	2663

CPC - Searched*		
Symbol	Date	Examiner

CPC Combination Sets - Searched*		
Symbol	Date	Examiner

US Classification - Searched*			
Class	Subclass	Date	Examiner

* See search history printout included with this form or the SEARCH NOTES box below to determine the scope of the search.

Search Notes		
Search Notes	Date	Examiner
Inventor name search	04/12/2019	vb
Limited text search in EAST and CPC - A61B$.CPC. A61C9$.CPC.	04/12/2019	vb
NPL search	04/12/2019	vb
Updated search	09/05/2019	vb
Updated seearch	09/25/2020	vb
NPL search terms - intra oral scan occlusal surface overlapping	09/25/2020	vb
Updated search	06/01/2021	vb

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	16/160,230	Dillon et al.
	Examiner	Art Unit
	VIKKRAM BALI	2663

Interference Search			
US Class/CPC Symbol	US Subclass/CPC Group	Date	Examiner

Index of Claims	Application/Control No.	Applicant(s)/Patent Under Reexamination
	16/160,230	Dillon et al.
	Examiner	Art Unit
	VIKKRAM BALI	2663

✓	Rejected	-	Cancelled	N	Non-Elected	A	Appeal
=	Allowed	÷	Restricted	I	Interference	O	Objected

CLAIMS

☐ Claims renumbered in the same order as presented by applicant ☐ CPA ☐ T.D. ☐ R.1.47

CLAIM		DATE								
Final	Original	04/12/2019	09/05/2019	05/21/2020	09/25/2020	06/01/2021				
	1	✓	✓	÷	✓	✓				
	2	✓	✓	÷	✓	✓				
	3	✓	✓	÷	✓	✓				
	4	✓	✓	÷	✓	✓				
	5	✓	✓	÷	✓	✓				
	6	✓	✓	÷	✓	✓				
	7	✓	✓	÷	✓	✓				
	8	✓	✓	÷	-	-				
	9	✓	✓	÷	-	-				
	10	✓	✓	÷	-	-				
	11	✓	✓	÷	✓	✓				
	12	✓	✓	÷	✓	✓				
	13	✓	✓	÷	✓	✓				
	14	✓	✓	÷	✓	✓				
	15	✓	✓	÷	✓	✓				
	16	✓	✓	÷	✓	✓				
	17	✓	✓	÷	✓	✓				
	18	✓	✓	÷	✓	✓				
	19	✓	✓	÷	✓	✓				
	20	✓	✓	÷	✓	✓				
	21	✓	✓	÷	✓	✓				
	22	✓	-	-	-	-				
	23	✓	-	-	-	-				
	24	✓	-	-	-	-				
	25			÷	-	-				
	26					O				
	27					O				
	28					✓				
	29					✓				

EAST Search History

EAST Search History (Prior Art)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
L1	2,389	((segment$4 differenc$4 substract$4) same (cheek lip tongue) same image)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2021/06/01 17:09
L2	421	L1 and (occlusal teeth tooth dentit$3 jaw)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2021/06/01 17:09
S1	10	"9622834".pn. "9157733".pn. "20120062557".pn.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2017/06/12 11:07
S2	2	S1 and (oral and imag$4 and cavity and (wand handpiece) and occlusal)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2017/06/12 11:08
S3	150	(oral and imag$4 and cavity and (wand handpiece) and occlusal)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2017/06/12 11:13
S4	39	S3 and (lingual and labial)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2017/06/12 11:14
S5	719	ormco.asn.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2017/06/12 11:22
S6	2	S5 and (oral and imag$4 and cavity and (wand handpiece) and occlusal)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2017/06/12 11:22
S7	11	S5 and (oral and imag$4 and cavity and project$3)	US-PGPUB; USPAT; USOCR;	OR	OFF	2017/06/12 11:24

			FPRS; EPO; JPO; DERWENT; IBM_TDB			
S8	5	S5 and (oral and imag$4 and cavity and project$3 and occlusal)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2017/06/12 11:28
S9	267	(dillon near robert).in.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2017/06/12 15:12
S10	218	(andreiko near craig).in.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2017/06/12 15:12
S11	12	(vesper near andrew).in.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2017/06/12 15:14
S12	178	(judell near neil).in.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2017/06/12 15:14
S13	41	(fillion near timothy).in.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2017/06/12 15:14
S14	598	S9 S10 S11 S12 S13	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2017/06/12 15:15
S15	13	S14 and (oral and imag$4 and cavity and project$3)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2017/06/12 15:18
S16	172,337	A61B$.CPC. A61C9$.CPC.	USPAT	OR	OFF	2017/06/12 16:05
S17	580	(oral and imag$4 and cavity and (wand handpiece scan$4) and	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO;	OR	OFF	2017/06/12 16:06

		occlusal and project$4 and (teeth tooth))	DERWENT; IBM_TDB			
S18	153	S16 and S17	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2017/06/12 16:07
S19	1	(oral and imag$4 and cavity and (wand handpiece scan$4) and occlusal and project$4 and (teeth tooth)).clm.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2017/06/12 16:07
S20	1	"8390822".pn.	USPAT	OR	OFF	2017/06/13 09:07
S21	0	S20 and (occlusal)	USPAT	OR	OFF	2017/06/13 09:10
S22	10	"9622834".pn. "9157733".pn. "20120062557".pn.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2017/06/13 09:15
S23	17	(backbone bone (back adj2 bone)) near occlusal	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2018/04/23 12:02
S24	2	("2014/0272774").URPN.	USPAT	OR	ON	2018/04/23 12:04
S25	1	(oral and imag$4 and cavity and (wand handpiece scan$4) and occlusal and project$4 and (teeth tooth)).clm.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2018/06/14 13:56
S26	17	s22s	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2018/06/14 13:56
S27	10	"9622834".pn. "9157733".pn. "20120062557".pn.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2018/06/14 13:56
S28	10	S27	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2018/06/14 13:56

S29	18	(backbone bone (back adj2 bone)) near occlusal	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2018/06/14 13:56
S30	18	S29	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2018/06/14 13:56
S31	186,805	A61B$.CPC. A61C9$.CPC.	USPAT	OR	OFF	2018/06/14 13:57
S32	675	(oral and imag$4 and cavity and (wand handpiece scan$4) and occlusal and project$4 and (teeth tooth))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2018/06/14 13:57
S33	187	S31 and S32	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2018/06/14 13:57
S34	187	S33	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2018/06/14 13:57
S35	199,441	A61B$.CPC. A61C9$.CPC.	USPAT	OR	OFF	2019/04/12 08:25
S36	739	(oral and imag$4 and cavity and (wand handpiece scan$4) and occlusal and project$4 and (teeth tooth))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2019/04/12 08:25
S37	211	S35 and S36	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2019/04/12 08:25
S38	307	(dillon near robert).in.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2019/04/12 08:26
S39	236	(andreiko near craig).in.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO;	OR	OFF	2019/04/12 08:26

			DERWENT; IBM_TDB			
S40	17	(vesper near andrew).in.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2019/04/12 08:26
S41	193	(judell near neil).in.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2019/04/12 08:26
S42	50	(fillion near timothy).in.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2019/04/12 08:26
S43	657	S38 S39 S40 S41 S42	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2019/04/12 08:26
S44	17	S43 and (oral and imag$4 and cavity and project$3)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2019/04/12 08:26
S45	8	("20040265770" | "20050058962" | "20120062557" | "20120129119" | "6402707" | "7717708" | "7905725" | "8390822").PN.	US-PGPUB; USPAT	OR	ON	2019/04/12 09:56
S46	4	"6648640".pn. "7286954".pn.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2019/04/12 13:27
S47	5	"20120062557".pn. "20040265770".pn.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2019/04/12 13:30
S48	0	S47 and (cheek lip tongue)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2019/04/12 13:30
S49	2	S47 and (color rigid$)	US-PGPUB; USPAT; USOCR;	OR	OFF	2019/04/12 13:31

			FPRS; EPO; JPO; DERWENT; IBM_TDB			
S50	50	"s362" and (cheek lip tongue)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2019/04/12 14:16
S51	739	(oral and imag$4 and cavity and (wand handpiece scan$4) and occlusal and project$4 and (teeth tooth))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2019/04/12 14:16
S52	278	S51 and (cheek lip tongue)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2019/04/12 14:16
S53	50	S51 and ((segment$4 differenc$4 substract$4) same (cheek lip tongue))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2019/04/12 14:17
S54	35	S51 and ((segment$4 differenc$4 substract$4) same (tongue))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2019/04/12 14:27
S55	489	((segment$4 differenc$4 substract$4) same (tongue) same image)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2019/04/12 15:56
S56	7	S51 and S55	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2019/04/12 15:56
S57	1,904	((segment$4 differenc$4 substract$4) same (cheek lip tongue) same image)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2019/04/12 15:58
S58	13	S51 and S57	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2019/04/12 15:59

S59	323	S57 and (occlusal teeth tooth dentit$3 jaw)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2019/04/12 16:14
S60	135	S57 same (occlusal teeth tooth dentit$3 jaw)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2019/04/12 16:14
S61	3	"20120062557".pn.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2019/09/05 07:55
S62	1	S61 and (labial lingual cloud noise)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2019/09/05 07:56
S63	8	("20040265770" | "20050058962" | "20120062557" | "20120129119" | "6402707" | "7717708" | "7905725" | "8390822").PN.	US-PGPUB; USPAT	OR	ON	2020/09/24 09:56
S64	8	S63	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2020/09/24 09:56
S65	6	S64 and occlusal	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2020/09/24 09:56
S66	4	"10098713".pn.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2020/09/24 11:50
S67	2	S66 and storage	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2020/09/24 11:50
S68	4	"10098713".pn.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2020/09/25 09:53

S69	1	S68 and coarse	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2020/09/25 09:53
S70	8	("20040265770" | "20050058962" | "20120062557" | "20120129119" | "6402707" | "7717708" | "7905725" | "8390822").PN.	US-PGPUB; USPAT	OR	ON	2020/09/25 09:55
S71	0	S70 and coarse	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2020/09/25 09:55
S72	7	S70 and (match$3 compar$4)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2020/09/25 09:55

EAST Search History (Interference)

<This search history is empty>

6/1/2021 5:10:17 PM
C:\Users\vbali\Documents\EAST\Workspaces\16160230.wsp

PTO/SB/06 (09-11)
Approved for use through 1/31/2014. OMB 0651-0032
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
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PATENT APPLICATION FEE DETERMINATION RECORD Substitute for Form PTO-875	Application or Docket Number 16/160,230	Filing Date 10/15/2018	☐ To be Mailed

ENTITY: ☑ LARGE ☐ SMALL ☐ MICRO

APPLICATION AS FILED - PART I

FOR	(Column 1) NUMBER FILED	(Column 2) NUMBER EXTRA		RATE ($)	FEE ($)
☐ BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A		N/A	
☐ SEARCH FEE (37 CFR 1.16(k), (i), or (m))	N/A	N/A		N/A	
☐ EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A		N/A	
TOTAL CLAIMS (37 CFR 1.16(i))	minus 20 =	*		x $100 =	
INDEPENDENT CLAIMS (37 CFR 1.16(h))	minus 3 =	*		x $460 =	
☐ APPLICATION SIZE FEE (37 CFR 1.16(s))	If the specification and drawings exceed 100 sheets of paper, the application size fee due is $310 ($155 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).				
☐ MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))					
* If the difference in column 1 is less than zero, enter "0" in column 2.				TOTAL	

APPLICATION AS AMENDED - PART II

		(Column 1)		(Column 2)	(Column 3)			
AMENDMENT	03/29/2021	CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA		RATE ($)	ADDITIONAL FEE ($)
	Total (37 CFR 1.16(i))	* 22	Minus	** 22	= 0		x $100 =	0
	Independent (37 CFR 1.16(h))	* 2	Minus	*** 3	= 0		x $480 =	0
	☐ Application Size Fee (37 CFR 1.16(s))							
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							
							TOTAL ADD'L FEE	0

		(Column 1)		(Column 2)	(Column 3)			
AMENDMENT		CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA		RATE ($)	ADDITIONAL FEE ($)
	Total (37 CFR 1.16(i))	*	Minus	**	=		x $0 =	
	Independent (37 CFR 1.16(h))	*	Minus	***	=		x $0 =	
	☐ Application Size Fee (37 CFR 1.16(s))							
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							
							TOTAL ADD'L FEE	

* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.	LIE
** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20".	/MARQUITA D JONES/
*** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3".	
The "Highest Number Previously Paid For" (Total or Independent) is the highest number found in the appropriate box in column 1.	

This collection of information is required by 37 CFR 1.16. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
Group Art Unit 2663

In re

Patent Application of

Robert F. Dillon *et al.*

Application No. 16/160,230

Confirmation No.: 8509

Filed: October 15, 2018

Examiner: Vikkram Bali

"SCANNING SEQUENCE FOR AN INTRA-ORAL IMAGING SYSTEM"

Atty. Docket No. 208764-9006-US02

AMENDMENT AND RESPONSE TO OFFICE ACTION

Mail Stop Amendment
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Commissioner:

This communication is in response to the non-final Office action mailed September 29, 2021 and is filed with a request for a three-month extension of the period for reply. Please charge or credit Deposit Account No. 13-3080 with any shortage or overpayment of the fees associated with this communication.

Amendments to the Claims begin on page 2 of this paper.

Remarks begin on page 10 of this paper.

AMENDMENTS TO THE CLAIMS:

This listing of claims will replace all prior versions, and listings, of claims in the application:

1. (Currently Amended) A system for generating an intra-oral scan of a dentition, the system comprising:

a memory; and

a processor coupled to the memory, wherein the processor is configured to:

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

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

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

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

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

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

2. (Previously Presented) The system of claim 1, wherein the processor is further configured to associate a plurality of scans of additional surfaces to the contiguous scan of the occlusal surface, wherein the plurality of scans of the additional surfaces includes a plurality of scans of labial surfaces and a plurality of scans of lingual surfaces.

3. (Previously Presented) The system of claim 1, wherein the plurality of image frames of the occlusal surface from the scan of the at least one additional surface each overlap with the contiguous scan of the occlusal surface,

wherein the plurality of images frames of the at least on additional surface includes image frames of a labial or lingual surface, and

wherein the processor is configured to use the plurality of image frames of the occlusal surface that is included in the scan of the at least one additional surface to determine a position of the image frames of the labial or lingual surface relative to the contiguous scan of the occlusal surface.

4. (Previously Presented) The system of claim 2, wherein the occlusal surface is imaged prior to the plurality of labial and lingual surfaces, and wherein the processor is further configured to display in real-time a three-dimensional representation of the dentition as the plurality of labial and lingual surfaces are imaged.

5. (Previously Presented) The system of claim 4, wherein the processor is configured to display in real-time the three-dimensional representation of the dentition by performing a coarse matching by matching features as the plurality of labial and lingual surfaces are imaged, and

wherein the processor is further configured to generate a three-dimensional reconstruction of the dentition based on a point cloud alignment after the plurality of labial and lingual surfaces are all imaged.

6. (Previously Presented) The system of claim 1, wherein the processor is further configured to generate an occlusal backbone by matching selected frames of the contiguous scan of the occlusal surface that have an overlap based on an analysis of data.

7. (Previously Presented) The system of claim 6, wherein the processor is configured to detect the overlap based on noise characteristics of the data.

8-10. (Cancelled)

11. (Previously Presented) The system of claim 1, further comprising:

a projector that projects interferometric fringes on an occlusal surface of at least a part of one arch of the dentition primarily along an anterior-posterior direction; and

an imaging sensor that is used to view the interferometric fringes,

wherein the processor is further configured to generate the contiguous scan of the occlusal surface based on the interferometric fringes sensed by the imaging sensor.

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

generate a contiguous scan of an occlusal surface of at least a part of one arch of the dentition;

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

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

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

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

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

13. (Previously Presented) The computer readable storage medium of claim 12, wherein the code, when executed by the processor, further causes the system to associate a plurality of

scans of additional surfaces to the contiguous scan of the occlusal surface, wherein the plurality of scans of the additional surfaces includes a plurality of scans of labial surfaces and a plurality of scans of lingual surfaces.

14. (Previously Presented) The computer readable storage medium of claim 12, wherein the plurality of image frames of the occlusal surface from the scan of the at least one additional surface each overlap with the contiguous scan of the occlusal surface,

wherein the plurality of image frames of the at least one additional surface includes image frames of a labial or lingual surface, and

wherein the code, when executed by the processor, causes the system to use the plurality of image frames of the occlusal surface that is included in the scan of the at least one additional surface to determine a position of the image frames of the labial or lingual surface relative to the contiguous scan of the occlusal surface.

15. (Previously Presented) The computer readable storage medium of claim 13, wherein the occlusal surface is imaged prior to the plurality of labial and lingual surfaces, and wherein the code, when executed by the processor, causes the system to display in real-time a three-dimensional representation of the dentition as the plurality of labial and lingual surfaces are imaged.

16. (Previously Presented) The computer readable storage medium of claim 15, wherein the code, when executed by the processor, causes the system to display in real-time the three-dimensional representation of the dentition by performing a coarse matching by matching features as the plurality of labial and lingual surfaces are imaged, and

wherein the code, when executed by the processor, further causes the system to generate a three-dimensional reconstruction of the dentition based on a point cloud alignment after the plurality of labial and lingual surfaces are all imaged.

17. (Previously Presented) The computer readable storage medium of claim 12, wherein the code, when executed by the processor, further causes the system to generate an occlusal backbone by matching selected frames of the contiguous scan of the occlusal surface that have an overlap based on an analysis of data.

18. (Previously Presented) The computer readable storage medium of claim 17, wherein the code, when executed by the processor, further causes the system to detect the overlap based on noise characteristics of the data.

19. (Previously Presented) The computer readable storage medium of claim 17, wherein the occlusal backbone is a first occlusal backbone, and wherein the code, when executed by the processor, further causes the system to generate a second occlusal backbone that is more accurate than the first occlusal backbone by linking other frames that are different from the selected frames to the first occlusal backbone.

20. (Currently Amended) The computer readable storage medium of claim 19, wherein the code, when executed by the processor, ~~further~~ causes the system to remove the image data of the soft tissue from the contiguous scan of the occlusal surface by generating ~~generate~~ a third occlusal backbone by removing, from the second occlusal backbone, areas representing the soft tissue ~~at least one selected from a group consisting of a tongue, a cheek, and a lip~~.

21. (Currently Amended) The computer readable storage medium of claim 20, wherein the code, when executed by the processor, causes the system to remove the image data of the soft tissue based at least in part on the analysis of 3D data from the contiguous scan by removing the image data of the soft tissue based at least in part on the analysis of the 3D data and at least one selected from a group consisting of ~~areas representing the at least one selected from the group consisting of the tongue, the cheek, and the lip based~~ a difference in ~~on differences in surface normal,~~ color[[, or]] and a difference in rigidity properties.

22-25. (Cancelled)

26. (New) The system of claim 1, wherein the processor is configured to generate the contiguous scan of the occlusal surface by capturing a plurality of partially overlapping image frames of the occlusal surface and stitching the overlapping image frames together to form a 3D model of the occlusal surface,

wherein the processor is configured to remove the image data of the soft tissue from the contiguous scan by removing the image data of the soft tissue from the overlapping image frames used to generate the occlusal scan, and

wherein the processor is further configured to update the contiguous scan of the occlusal surface by restitching the overlapping image frames together after removing the image data of the soft tissue to form an updated 3D model of the occlusal surface.

27. (New) The computer readable storage medium of claim 12, wherein the code stored in the computer readable storage medium, when executed by the processor, causes the system to:

generate the contiguous scan of the occlusal surface by capturing a plurality of partially overlapping image frames of the occlusal surface and stitching the overlapping image frames together to form a 3D model of the occlusal surface, and

remove the image data of the soft tissue from the contiguous scan by removing the image data of the soft tissue from the overlapping image frames used to generate the occlusal scan, and

wherein the code stored in the computer readable storage medium, when executed by the processor, further cause the system to update the contiguous scan of the occlusal surface by restitching the overlapping image frames together after removing the after removing the image data of the soft tissue to form an updated 3D model of the occlusal surface.

28. (New) The system of claim 1, wherein the processor is configured to remove the image data of soft tissue from the contiguous scan of the occlusal surface based at least in part on the analysis of 3D data from the contiguous scan by distinguishing between the image data of the dentition and the image data of the soft tissue based at least in part on a comparison of surface normals of 3D structures in the contiguous scan.

29. (New) The computer readable storage medium of claim 12, wherein the code stored in the computer readable storage medium, when executed by the processor, cause the system to remove the image data of soft tissue from the contiguous scan of the occlusal surface based at least in part on the analysis of 3D data from the contiguous scan by distinguishing between the image data of the dentition and the image data of the soft tissue based at least in part on a comparison of surface normals of 3D structures in the contiguous scan.

REMARKS

By this Amendment, claims 1, 12, 20, and 21 are amended and new claims 26-29 have been added. After entry of this Amendment, claims 1-7, 11-21, and 26-29 remain pending.

Claims 1-7 and 11-19 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over U.S. Publication No. 2004/0265770 to Chapoulaud et al. (hereinafter, "Chapoulaud") in view of U.S. Publication No. 2012/0062557 to Dillon et al. (hereinafter, "Dillon"). Claims 20 and 21 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Chapoulaud and Dillon in further view of U.S. Publication No. 2013/0218530 to Deichmann et al. (hereinafter, "Deichmann").

Independent claims 1 and 12 have been amended based in part on subject matter previously recited in dependent claims 20 and 21. In particular, claims 1 and 12 now recite in part: "remov[ing] image data of soft tissue from the contiguous scan of the occlusal surface based at least in part on an analysis of 3D data from the contiguous scan to distinguish between image data of the dentition and the image data of the soft tissue, wherein the soft tissue includes at least one selected from a group consisting of a tongue, a cheek, and a lip." Accordingly, claims 1 and 12 define a system and a computer readable storage medium, respectively, that are configured to generate a contiguous scan of an occlusal surface of a dental arch (i.e., a scan of the "top" of the teeth), to remove soft tissue image data based on 3D data derived from the scan of the occlusal surface, and to generate a 3D model of the dentition by associating & appending additional scan data of other surfaces of the dentition to the scan of the occlusal surface.

In rejecting claims 20 and 21, the Examiner conceded that Chapoulaud and Dillon both fail to teach or suggest removing image data representing tongue, cheek, or lips from the contiguous scan (i.e. from the constructed "occlusal backbone"). Instead, the Examiner argues that Deichmann teaches segmenting image data corresponding to the lip and image data corresponding to the teeth by using a color difference (Office action, page 8, citing Deichmann, para. [0101]). However, Deichmann does not teach or suggest differentiating between image data of soft tissues (e.g., tongue, cheek, and/or lip) and image data of teeth based on an analysis of 3D data (e.g., shape, contour, surface normals, etc.) as required by

independent claims 1 and 12. Therefore, Deichmann does not cure the deficiencies of Chapoulaud and Dillon with respect to the subject matter defined by indpeendnet claims 1 and 12 as amended.

For at least these reasons, Chapoulaud, Dillon, and Deichmann, alone or in combination, fail to disclose or render obvious the subject matter defined by independent claims 1 and 12. Therefore, claims 1 and 12 are allowable. Claims 2-7, 11, 26, & 28 and claims 13-21, 27 & 29 depend from claims 1 and 12, respectively, and are allowable for the same reasons and also because they recite additional patentable subject matter.

For example, dependent claims 26 and 27 further recite a process for generating a "contiguous scan" of the occlusal surface by (1) stitching together overlapping frames of image data to generate a 3D model of the occlusal surface, (2) removing soft tissue image data based on a "surface normal" analysis of the 3D contiguous scan, and (3) re-stitching the overlapping image frames after removing the soft tissue image data to form an updated 3D model of the occlusal surface. Generating a first "contiguous scan" based on the captured image data allows the system to use an analysis of 3D structures (i.e., surface normal in particular) to distinguish between teeth & soft tissue in the image data and restitching the image data to form a second "contiguous scan" after removing the soft tissue image data allows the system to produce an improved 3D model of the dentition.

This combination of stitching image data to form a 3D model, removing soft tissue image data based on an analysis of the 3D model, and then restitching the image data to form an updated 3D model (after the soft tissue image data has been removed) is not taught or suggested by any of the references cited by the Examiner.

CONCLUSION

In view of the above, the Applicant respectfully requests entry of this Amendment and allowance of claims 1-7, 11-21, and 26-29. The undersigned is available for telephone consultation at the number below during normal business hours.

Respectfully submitted,

/andrew.j.paprocki/

Andrew J. Paprocki
Reg. No. 60,308

File No. 208764-9006-US02
Michael Best & Friedrich LLP
790 N. Water Street, Ste. 2500
Milwaukee, Wisconsin 53202
414-225-4947

PTO/AIA/22 (10-20)
Approved for use through 11/30/2020. OMB 0651-0031
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Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

PETITION FOR EXTENSION OF TIME UNDER 37 CFR 1.136(a)	Docket Number (Optional) 208764-9006-US02
Application Number 16/160,230	Filed October 15, 2018
For SCANNING SEQUENCE FOR AN INTRA-ORAL IMAGING SYSTEM	
Art Unit 2663	Examiner Vikkram Bali

This is a request under the provisions of 37 CFR 1.136(a) to extend the period for filing a reply in the above-identified application.

The requested extension and fee are as follows (check time period desired and enter the appropriate fee below):

		Fee	Small Entity Fee	Micro Entity Fee	
☐	One month (37 CFR 1.17(a)(1))	$220	$110	$55	$
☐	Two months (37 CFR 1.17(a)(2))	$640	$320	$160	$
☑	Three months (37 CFR 1.17(a)(3))	$1,480	$740	$370	$ 1480
☐	Four months (37 CFR 1.17(a)(4))	$2,320	$1,160	$580	$
☐	Five months (37 CFR 1.17(a)(5))	$3,160	$1,580	$790	$

☐ Applicant asserts small entity status. See 37 CFR 1.27.

☐ Applicant certifies micro entity status. See 37 CFR 1.29.
Form PTO/SB/15A or B or equivalent must either be enclosed or have been submitted previously.

☐ A check in the amount of the fee is enclosed.

☐ Payment by credit card. Form PTO-2038 is attached.

☐ The Director has already been authorized to charge fees in this application to a Deposit Account.

☑ The Director is hereby authorized to charge any fees which may be required, or credit any overpayment, to Deposit Account Number 13-3080.

☑ Payment made via EFS-Web.

WARNING: Information on this form may become public. Credit card information should not be included on this form. Provide credit card information and authorization on PTO-2038.

I am the

☐ applicant.

☑ attorney or agent of record. Registration number 60,308.

☐ attorney or agent acting under 37 CFR 1.34. Registration number _____.

/andrew j. paprocki/	March 29, 2021
Signature	Date
Andrew J. Paprocki	414-271-6560
Typed or printed name	Telephone Number

NOTE: This form must be signed in accordance with 37 CFR 1.33. See 37 CFR 1.4 for signature requirements and certifications. Submit multiple forms if more than one signature is required, see below*.

☑ * Total of 1 forms are submitted.

This collection of information is required by 37 CFR 1.136(a). The information is required to obtain or retain a benefit by the public, which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 6 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Mail Stop PCT, Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.

Electronic Patent Application Fee Transmittal

Application Number:	16160230
Filing Date:	15-Oct-2018
Title of Invention:	SCANNING SEQUENCE FOR AN INTRA-ORAL IMAGING SYSTEM
First Named Inventor/Applicant Name:	Robert F. Dillon
Filer:	Andrew J. Paprocki/Elizabeth Tressler
Attorney Docket Number:	208764-9006-US02

Filed as Large Entity

Filing Fees for Utility under 35 USC 111(a)

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
Pages:				
Claims:				
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				
Extension-of-Time:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Extension - 3 months with $0 paid	1253	1	1480	1480
Miscellaneous:				
			Total in USD ($)	**1480**

Electronic Acknowledgement Receipt

EFS ID:	42305032
Application Number:	16160230
International Application Number:	
Confirmation Number:	8509
Title of Invention:	SCANNING SEQUENCE FOR AN INTRA-ORAL IMAGING SYSTEM
First Named Inventor/Applicant Name:	Robert F. Dillon
Customer Number:	129916
Filer:	Andrew J. Paprocki/Elizabeth Tressler
Filer Authorized By:	Andrew J. Paprocki
Attorney Docket Number:	208764-9006-US02
Receipt Date:	29-MAR-2021
Filing Date:	15-OCT-2018
Time Stamp:	14:47:18
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	CARD
Payment was successfully received in RAM	$1480
RAM confirmation Number	E20213SE47430340
Deposit Account	133080
Authorized User	Elizabeth Tressler

The Director of the USPTO is hereby authorized to charge indicated fees and credit any overpayment as follows:

37 CFR 1.16 (National application filing, search, and examination fees)

37 CFR 1.17 (Patent application and reexamination processing fees)

37 CFR 1.19 (Document supply fees)

37 CFR 1.20 (Post Issuance fees)

37 CFR 1.21 (Miscellaneous fees and charges)

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1		208764-9006-US02_Response_filed_3-29-2021.pdf	116608 22e38970ec3585d0c6a633d66d7347301067e970	yes	12
	Multipart Description/PDF files in .zip description				
	Document Description		**Start**	**End**	
	Amendment/Req. Reconsideration-After Non-Final Reject		1	1	
	Claims		2	9	
	Applicant Arguments/Remarks Made in an Amendment		10	12	
Warnings:					
Information:					
2	Extension of Time	208764-9006-US02_Extension_filed_3-29-2021.pdf	158591 4753b8d6fe43045518a04c74a93c772491d2646c	no	1
Warnings:					
Information:					
3	Fee Worksheet (SB06)	fee-info.pdf	31210 b3d068f8235bc1fa477df19d1cd4b4ea034eccd4	no	2
Warnings:					
Information:					
		Total Files Size (in bytes):	306409		

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

UNITED STATES DEPARTMENT OF COMMERCE
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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
16/160,230	10/15/2018	Robert F. Dillon	208764-9006-US02	8509

129916 7590 09/29/2020

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EXAMINER	
BALI, VIKKRAM	

ART UNIT	PAPER NUMBER
2663	

NOTIFICATION DATE	DELIVERY MODE
09/29/2020	ELECTRONIC

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

mkeipdocket@michaelbest.com

Office Action Summary	Application No. 16/160,230	Applicant(s) Dillon et al.	
	Examiner VIKKRAM BALI	Art Unit 2663	AIA (FITF) Status No

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTHS FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☑ Responsive to communication(s) filed on 9/18/2020.

☐ A declaration(s)/affidavit(s) under **37 CFR 1.130(b)** was/were filed on _____.

2a)☐ This action is **FINAL.** 2b) ☑ This action is non-final.

3)☐ An election was made by the applicant in response to a restriction requirement set forth during the interview on _____; the restriction requirement and election have been incorporated into this action.

4)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims*

5) ☑ Claim(s) 1-7 and 11-21 is/are pending in the application.

5a) Of the above claim(s) _____ is/are withdrawn from consideration.

6) ☐ Claim(s) _____ is/are allowed.

7) ☑ Claim(s) 1-7 and 11-21 is/are rejected.

8) ☐ Claim(s) _____ is/are objected to.

9) ☐ Claim(s) _____ are subject to restriction and/or election requirement

* If any claims have been determined allowable, you may be eligible to benefit from the **Patent Prosecution Highway** program at a participating intellectual property office for the corresponding application. For more information, please see http://www.uspto.gov/patents/init_events/pph/index.jsp or send an inquiry to **PPHfeedback@uspto.gov.**

Application Papers

10)☐ The specification is objected to by the Examiner.

11)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

Certified copies:

a)☐ All b)☐ Some** c)☐ None of the:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

** See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)

2) ☐ Information Disclosure Statement(s) (PTO/SB/08a and/or PTO/SB/08b) Paper No(s)/Mail Date _____.

3) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date _____.

4) ☐ Other: _____.

Notice of Pre-AIA or AIA Status

The present application is being examined under the pre-AIA first to invent provisions.

All amendments to the claims as filled on 9/18/2020 have been entered and the action follows:

Response to Arguments

Applicant's arguments filed on 3/11/2020 have been fully considered but they are not persuasive.

Applicant argues that newly added limitation is not taught in the reference Dillon.

Examiner respectfully disagrees reference Dillon in paragraph 0039 teaches illuminating and scanning occlusal surface of a patient using a scanning device 12 and then in paragraph 0040 it discloses that if needed a clinician can move the scanning device to another surface of second region to obtain more images of the occlusal surface i.e. "one additional surface to the contiguous scan of the occlusal surface by analyzing the scan data to identify a portion of the scan of the at least one additional surface that overlaps with a portion of the contiguous scan of the occlusal surface, wherein the scan of the at least one additional surface includes a sequence of image frames including a plurality of image frames of the occlusal surface interspersed with a plurality of image frames of the at least one additional surface" as claimed.

Applicant also argues that "regardless of whether or not **Dillon** teaches a "point cloud alignment**,"** it **fails to teach a system configured to use two different 3D reconstruction**

techniques as required by claim 5.", (see Remarks page 12). This limitation of using two different 3D techniques is not claimed in claim 5.

Claim Rejections - 35 USC § 103

1. The following is a quotation of pre-AIA 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

2. Claims 1-7 and 11-19 are rejected under pre-AIA 35 U.S.C. 103(a) as being unpatentable over Chapoulaud et al (US 2004/0265770) in view of Dillon et al (US 2012/0062557).

With respect to claim 1, Chapoulaud discloses generating a scan of a dentition, the system comprising (see Abstract):

a memory; a processor coupled to the memory, wherein the processor is configured to (see figure 1):

generate a contiguous scan of an occlusal surface of at least a part of one arch of the dentition, (see figure 1, 3, 3A, 3B, and 4, and paragraph 0071) as claimed.

However, he fails to disclose associate a scan of at least one additional surface to the contiguous scan of the occlusal surface by analyzing the scan data to identify a portion of the scan of the at least one additional surface that overlaps with a portion of the contiguous scan of the occlusal surface, wherein the scan of the at least one additional surface includes a sequence of image frames including a plurality of image frames of the occlusal surface interspersed with a plurality of image frames of the at

least one additional surface, and determining a position of the scan of the at least one additional surface relative to the scan of the occlusal surface based on the identified overlapping portions, as claimed.

Dillon in the same field of art to generate an intra-oral scan of a dentition (see Abstract) teaches associate a scan of at least one additional surface to the contiguous scan of the occlusal surface by analyzing the scan data to identify a portion of the scan of the at least one additional surface that overlaps with a portion of the contiguous scan of the occlusal surface, wherein the scan of the at least one additional surface includes a sequence of image frames including a plurality of image frames of the occlusal surface interspersed with a plurality of image frames of the at least one additional surface, and determining a position of the scan of the at least one additional surface relative to the scan of the occlusal surface based on the identified overlapping portions, (see figures 4A-4C, and paragraphs 0055-0056, also paragraph 0039 teaches illuminating and scanning occlusal surface of a patient using a scanning device 12 and then in paragraph 0040 it discloses that if needed a clinician can move the scanning device to another surface of second region to obtain more images of the occlusal surface) as claimed.

Therefore, it would have been obvious to one ordinary skilled in the art at the time of invention to combine the two references as they are analogous because they are solving similar problem of intra oral scanning. The teachings of Dillon of data display in real time using the 3D display can be incorporated into Chapoulaud's system for the ease of the system.

With respect to claim 2, combination of Chapoulaud and Dillon further discloses the processor is further configured to associate a plurality of scans of additional surfaces to the contiguous scan of the occlusal surface, wherein the plurality of scans of the additional surfaces includes a plurality of scans of labial surfaces and a plurality of scans of lingual surfaces, (see Chapoulaud figure 4, and paragraph 0071) as claimed.

With respect to claim 3, combination of Chapoulaud and Dillon further discloses wherein the plurality of image frames of the occlusal surface from the scan of the at least one additional surface each overlap with the contiguous scan of the occlusal surface, wherein the plurality of images frames of the at least on additional surface includes image frames of a labial or lingual surface, and wherein the processor is configured to use the plurality of image frames of the occlusal surface that is included in the scan of the at least one additional surface to determine a position of the image frames of the labial or lingual surface relative to the contiguous scan of the occlusal surface., (see Chapoulaud figure 4 and paragraph 0071) as claimed.

With respect to claim 4, combination of Chapoulaud and Dillon further discloses wherein the occlusal surface is imaged prior to the plurality of labial and lingual surfaces, and wherein the processor is further configured to display in real-time a three-dimensional representation of the dentition as the plurality of labial and lingual surfaces are imaged, (see Chapoulaud figure 4) as claimed.

With respect to claim 5, combination of Chapoulaud and Dillon further discloses wherein the processor is configured to display in real-time the three-dimensional representation of the dentition by performing a coarse matching by matching features as the plurality of labial and lingual surfaces are imaged, and wherein the processor is further configured to generate a three-dimensional reconstruction of the dentition based on a point cloud alignment after the plurality of labial and lingual surfaces are all imaged, (see Dillon in paragraph 0046, states that the 3D representation is in point cloud, and in paragraph 0043, the figure 4B, is the display of the 3D point cloud, and figure 4B is the display of two scans put together i.e. aligned; also paragraph 0022 states the current video image "additional surface" is match to the previous or displayed data), as claimed.

With respect to claim 6, combination of Chapoulaud and Dillon further discloses wherein the processor is further configured to generate an occlusal backbone by matching selected frames of the contiguous scan of the occlusal surface that have an overlap based on an analysis of data, (see Chapoulaud figure 3A, 3B, and 4, and paragraph 0071) as claimed.

With respect to claim 7, combination of Chapoulaud and Dillon further discloses wherein the processor is configured to detect the overlap based on noise characteristics of the data, (see Dillon paragraph 0037, right hand column last 6 lines, checking if the two displays are similar "noise characteristics") as claimed.

With respect to claim 11, combination of Chapoulaud and Dillon further discloses a projector that projects interferometric fringes on an occlusal surface of at least a part of one arch of the dentition primarily along an anterior-posterior direction; and an imaging sensor that is used to view the interferometric fringes, wherein the processor is further configured to generate the contiguous scan of the occlusal surface based on the interferometric fringes sensed by the imaging sensor, as claimed, (see Dillon figure 2, numerical 22, and paragraph 0028), as claimed.

Claims 12-15 and 17, are for the same reason as set forth in the rejections for claims 1-4 and 6, because claims 12-15 and 17 are claiming subject matter similar to the claimed subject in claims 1-4 and 6.

Claims 16 and 18, are for the same reason as set forth in the rejections for claims 5 and 7, because claims 16 and 18 are claiming subject matter similar to the claimed subject in claims 5 and 7.

With respect to claim 19, combination of Chapoulaud and Dillon further discloses wherein the occlusal backbone is a first occlusal backbone, and wherein the code, when executed by the processor, further causes the system to generate a second occlusal backbone that is more accurate than the first occlusal backbone by linking other frames that are different from the selected frames to the first occlusal backbone., (see Chapoulaud paragraph 0071, low and high resolution imaging is read as first and second occlusal backbone imaging) as claimed.

3. Claims 20 and 21 are rejected under pre-AIA 35 U.S.C. 103(a) as being unpatentable over Chapoulaud et al (US 2004/0265770) in view of Dillon et al (US 2012/0062557) as applied to claim 8 above, and further in view of Deichmann et al (US Pub. 2013/0218530).

With respect to claims 20 and 21, Chapoulaud and Dillon discloses all the limitations as claimed in claim 19 and as rejected above. However, they fails to disclose wherein the code, when executed by the processor, further causes the system to generate a third occlusal backbone by removing, from the second occlusal backbone, areas representing at least one selected from a group consisting of a tongue, a cheek, and a lip; and wherein the code, when executed by the processor, causes the system to remove the areas representing the at least one selected from the group consisting of the tongue, the cheek, and the lip based on differences in surface normal, color, or rigidity properties, as claimed.

Deichmann in the same field teaches wherein the code, when executed by the processor, further causes the system to generate a third occlusal backbone by removing, from the second occlusal backbone, areas representing at least one selected from a group consisting of a tongue, a cheek, and a lip; and wherein the code, when executed by the processor, causes the system to remove the areas representing the at least one selected from the group consisting of the tongue, the cheek, and the lip based on differences in surface normal, color, or rigidity properties, (see paragraph 0101, wherein the a segmenting is performed to cutoff the lip and teeth image in order to get the image using a color difference) as claimed.

Therefore, it would have been obvious to one ordinary skilled in the art at the time of invention to combine the references as they are analogous because they are solving similar problem of intra oral scanning. The teachings of Deichmann of segmenting the images to get the clear image of teeth can be incorporated into Chapoulaud's and Dillon system to yield the clear imagery.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to VIKKRAM BALI whose telephone number is (571)272-7415. The examiner can normally be reached on Monday-Friday 7:00AM-3:00PM.

Examiner interviews are available via telephone, in-person, and video conferencing using a USPTO supplied web-based collaboration tool. To schedule an interview, applicant is encouraged to use the USPTO Automated Interview Request (AIR) at http://www.uspto.gov/interviewpractice.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Dwayne Bost can be reached on 571-272-7023. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see https://ppair-my.uspto.gov/pair/PrivatePair. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/VIKKRAM BALI/
Primary Examiner, Art Unit 2663

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	16/160,230	Dillon et al.
	Examiner	Art Unit
	VIKKRAM BALI	2663

CPC - Searched*		
Symbol	Date	Examiner

CPC Combination Sets - Searched*		
Symbol	Date	Examiner

US Classification - Searched*			
Class	Subclass	Date	Examiner

* See search history printout included with this form or the SEARCH NOTES box below to determine the scope of the search.

Search Notes		
Search Notes	Date	Examiner
Inventor name search	04/12/2019	vb
Limited text search in EAST and CPC - A61B$.CPC. A61C9$.CPC.	04/12/2019	vb
NPL search	04/12/2019	vb
Updated search	09/05/2019	vb
Updated seearch	09/25/2020	vb
NPL search terms - intra oral scan occlusal surface overlapping	09/25/2020	vb

Interference Search			
US Class/CPC Symbol	US Subclass/CPC Group	Date	Examiner

Index of Claims	Application/Control No.	Applicant(s)/Patent Under Reexamination
	16/160,230	Dillon et al.
	Examiner	Art Unit
	VIKKRAM BALI	2663

✓	Rejected	-	Cancelled	N	Non-Elected	A	Appeal
=	Allowed	÷	Restricted	I	Interference	O	Objected

CLAIMS

☐ Claims renumbered in the same order as presented by applicant ☐ CPA ☐ T.D. ☐ R.1.47

CLAIM		DATE								
Final	Original	04/12/2019	09/05/2019	05/21/2020	09/25/2020					
	1	✓	✓	÷	✓					
	2	✓	✓	÷	✓					
	3	✓	✓	÷	✓					
	4	✓	✓	÷	✓					
	5	✓	✓	÷	✓					
	6	✓	✓	÷	✓					
	7	✓	✓	÷	✓					
	8	✓	✓	÷	-					
	9	✓	✓	÷	-					
	10	✓	✓	÷	-					
	11	✓	✓	÷	✓					
	12	✓	✓	÷	✓					
	13	✓	✓	÷	✓					
	14	✓	✓	÷	✓					
	15	✓	✓	÷	✓					
	16	✓	✓	÷	✓					
	17	✓	✓	÷	✓					
	18	✓	✓	÷	✓					
	19	✓	✓	÷	✓					
	20	✓	✓	÷	✓					
	21	✓	✓	÷	✓					
	22	✓	-	-	-					
	23	✓	-	-	-					
	24	✓	-	-	-					
	25			÷	-					

EAST Search History

EAST Search History (Prior Art)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
L1	4	"10098713".pn.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2020/09/25 09:53
L2	1	L1 and coarse	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2020/09/25 09:53
L3	8	("20040265770" | "20050058962" | "20120062557" | "20120129119" | "6402707" | "7717708" | "7905725" | "8390822").PN.	US-PGPUB; USPAT	OR	ON	2020/09/25 09:55
L4	0	L3 and coarse	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2020/09/25 09:55
L5	7	L3 and (match$3 compar$4)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2020/09/25 09:55
S1	10	"9622834".pn. "9157733".pn. "20120062557".pn.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2017/06/12 11:07
S2	2	S1 and (oral and imag$4 and cavity and (wand handpiece) and occlusal)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2017/06/12 11:08
S3	150	(oral and imag$4 and cavity and (wand handpiece) and occlusal)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2017/06/12 11:13
S4	39	S3 and (lingual and labial)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO;	OR	OFF	2017/06/12 11:14

			DERWENT; IBM_TDB			
S5	719	ormco.asn.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2017/06/12 11:22
S6	2	S5 and (oral and imag$4 and cavity and (wand handpiece) and occlusal)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2017/06/12 11:22
S7	11	S5 and (oral and imag$4 and cavity and project$3)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2017/06/12 11:24
S8	5	S5 and (oral and imag$4 and cavity and project$3 and occlusal)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2017/06/12 11:28
S9	267	(dillon near robert).in.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2017/06/12 15:12
S10	218	(andreiko near craig).in.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2017/06/12 15:12
S11	12	(vesper near andrew).in.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2017/06/12 15:14
S12	178	(judell near neil).in.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2017/06/12 15:14
S13	41	(fillion near timothy).in.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2017/06/12 15:14

S14	598	S9 S10 S11 S12 S13	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2017/06/12 15:15
S15	13	S14 and (oral and imag$4 and cavity and project$3)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2017/06/12 15:18
S16	172,337	A61B$.CPC. A61C9$.CPC.	USPAT	OR	OFF	2017/06/12 16:05
S17	580	(oral and imag$4 and cavity and (wand handpiece scan$4) and occlusal and project$4 and (teeth tooth))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2017/06/12 16:06
S18	153	S16 and S17	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2017/06/12 16:07
S19	1	(oral and imag$4 and cavity and (wand handpiece scan$4) and occlusal and project$4 and (teeth tooth)).clm.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2017/06/12 16:07
S20	1	"8390822".pn.	USPAT	OR	OFF	2017/06/13 09:07
S21	0	S20 and (occlusal)	USPAT	OR	OFF	2017/06/13 09:10
S22	10	"9622834".pn. "9157733".pn. "20120062557".pn.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2017/06/13 09:15
S23	17	(backbone bone (back adj2 bone)) near occlusal	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2018/04/23 12:02
S24	2	("2014/0272774").URPN.	USPAT	OR	ON	2018/04/23 12:04
S25	1	(oral and imag$4 and cavity and (wand handpiece scan$4) and occlusal and project$4 and (teeth tooth)).clm.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2018/06/14 13:56

S26	17	s22s	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2018/06/14 13:56
S27	10	"9622834".pn. "9157733".pn. "20120062557".pn.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2018/06/14 13:56
S28	10	S27	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2018/06/14 13:56
S29	18	(backbone bone (back adj2 bone)) near occlusal	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2018/06/14 13:56
S30	18	S29	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2018/06/14 13:56
S31	186,805	A61B$.CPC. A61C9$.CPC.	USPAT	OR	OFF	2018/06/14 13:57
S32	675	(oral and imag$4 and cavity and (wand handpiece scan$4) and occlusal and project$4 and (teeth tooth))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2018/06/14 13:57
S33	187	S31 and S32	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2018/06/14 13:57
S34	187	S33	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2018/06/14 13:57
S35	199,441	A61B$.CPC. A61C9$.CPC.	USPAT	OR	OFF	2019/04/12 08:25
S36	739	(oral and imag$4 and cavity and (wand handpiece scan$4) and occlusal and project$4 and (teeth tooth))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO;	OR	OFF	2019/04/12 08:25

			DERWENT; IBM_TDB			
S37	211	S35 and S36	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2019/04/12 08:25
S38	307	(dillon near robert).in.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2019/04/12 08:26
S39	236	(andreiko near craig).in.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2019/04/12 08:26
S40	17	(vesper near andrew).in.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2019/04/12 08:26
S41	193	(judell near neil).in.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2019/04/12 08:26
S42	50	(fillion near timothy).in.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2019/04/12 08:26
S43	657	S38 S39 S40 S41 S42	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2019/04/12 08:26
S44	17	S43 and (oral and imag$4 and cavity and project$3)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2019/04/12 08:26
S45	8	("20040265770" | "20050058962" | "20120062557" | "20120129119" | "6402707" | "7717708" | "7905725" | "8390822").PN.	US-PGPUB; USPAT	OR	ON	2019/04/12 09:56
S46	4	"6648640".pn. "7286954".pn.	US-PGPUB; USPAT; USOCR;	OR	OFF	2019/04/12 13:27

			FPRS; EPO; JPO; DERWENT; IBM_TDB			
S47	5	"20120062557".pn. "20040265770".pn.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2019/04/12 13:30
S48	0	S47 and (cheek lip tongue)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2019/04/12 13:30
S49	2	S47 and (color rigid$)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2019/04/12 13:31
S50	50	"s362" and (cheek lip tongue)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2019/04/12 14:16
S51	739	(oral and imag$4 and cavity and (wand handpiece scan$4) and occlusal and project$4 and (teeth tooth))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2019/04/12 14:16
S52	278	S51 and (cheek lip tongue)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2019/04/12 14:16
S53	50	S51 and ((segment$4 differenc$4 substract$4) same (cheek lip tongue))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2019/04/12 14:17
S54	35	S51 and ((segment$4 differenc$4 substract$4) same (tongue))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2019/04/12 14:27
S55	489	((segment$4 differenc$4 substract$4) same (tongue) same image)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2019/04/12 15:56

S56	7	S51 and S55	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2019/04/12 15:56
S57	1,904	((segment$4 differenc$4 substract$4) same (cheek lip tongue) same image)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2019/04/12 15:58
S58	13	S51 and S57	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2019/04/12 15:59
S59	323	S57 and (occlusal teeth tooth dentit$3 jaw)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2019/04/12 16:14
S60	135	S57 same (occlusal teeth tooth dentit$3 jaw)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2019/04/12 16:14
S61	3	"20120062557".pn.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2019/09/05 07:55
S62	1	S61 and (labial lingual cloud noise)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2019/09/05 07:56
S63	8	("20040265770" | "20050058962" | "20120062557" | "20120129119" | "6402707" | "7717708" | "7905725" | "8390822").PN.	US-PGPUB; USPAT	OR	ON	2020/09/24 09:56
S64	8	S63	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2020/09/24 09:56
S65	6	S64 and occlusal	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2020/09/24 09:56

S66	4	"10098713".pn.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2020/09/24 11:50
S67	2	S66 and storage	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2020/09/24 11:50

9/25/2020 10:22:53 AM
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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
Group Art Unit 2663

In re

Patent Application of

Robert F. Dillon *et al.*

Application No. 16/160,230

Confirmation No.: 8509

Filed: October 15, 2018

Examiner: Vikkram Bali

"SCANNING SEQUENCE FOR AN INTRA-ORAL IMAGING SYSTEM"

Atty. Docket No. 208764-9006-US02

RESPONSE TO RESTRICTION REQUIREMENT

Mail Stop Amendment
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

This communication is in response to the Restriction Requirement mailed May 27, 2020, and is filed with a request for a two-month extension of the period for reply. Please charge or credit Deposit Account No. 13-3080 with any shortage or overpayment of the fees associated with this communication.

Amendments to the Claims begin on page 2 of this paper.

Remarks begin on page 8 of this paper.

AMENDMENTS TO THE CLAIMS:

This listing of claims will replace all prior versions, and listings, of claims in the application:

1. (Previously Presented) A system for generating an intra-oral scan of a dentition, the system comprising:

a memory; and

a processor coupled to the memory, wherein the processor is configured to:

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

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

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

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

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

2. (Previously Presented) The system of claim 1, wherein the processor is further configured to associate a plurality of scans of additional surfaces to the contiguous scan of the occlusal surface, wherein the plurality of scans of the additional surfaces includes a plurality of scans of labial surfaces and a plurality of scans of lingual surfaces.

3. (Previously Presented) The system of claim 1, wherein the plurality of image frames of the occlusal surface from the scan of the at least one additional surface each overlap with the contiguous scan of the occlusal surface,

wherein the plurality of images frames of the at least on additional surface includes image frames of a labial or lingual surface, and

wherein the processor is configured to use the plurality of image frames of the occlusal surface that is included in the scan of the at least one additional surface to determine a position of the image frames of the labial or lingual surface relative to the contiguous scan of the occlusal surface.

4. (Previously Presented) The system of claim 2, wherein the occlusal surface is imaged prior to the plurality of labial and lingual surfaces, and wherein the processor is further configured to display in real-time a three-dimensional representation of the dentition as the plurality of labial and lingual surfaces are imaged.

5. (Previously Presented) The system of claim 4, wherein the processor is configured to display in real-time the three-dimensional representation of the dentition by performing a coarse matching by matching features as the plurality of labial and lingual surfaces are imaged, and

wherein the processor is further configured to generate a three-dimensional reconstruction of the dentition based on a point cloud alignment after the plurality of labial and lingual surfaces are all imaged.

6. (Previously Presented) The system of claim 1, wherein the processor is further configured to generate an occlusal backbone by matching selected frames of the contiguous scan of the occlusal surface that have an overlap based on an analysis of data.

7. (Previously Presented) The system of claim 6, wherein the processor is configured to detect the overlap based on noise characteristics of the data.

8-10. (Cancelled)

11. (Previously Presented) The system of claim 1, further comprising:

a projector that projects interferometric fringes on an occlusal surface of at least a part of one arch of the dentition primarily along an anterior-posterior direction; and

an imaging sensor that is used to view the interferometric fringes,

wherein the processor is further configured to generate the contiguous scan of the occlusal surface based on the interferometric fringes sensed by the imaging sensor.

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

generate a contiguous scan of an occlusal surface of at least a part of one arch of the dentition; and

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

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

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

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

13. (Previously Presented) The computer readable storage medium of claim 12, wherein the code, when executed by the processor, further causes the system to associate a plurality of scans of additional surfaces to the contiguous scan of the occlusal surface, wherein the plurality of scans of the additional surfaces includes a plurality of scans of labial surfaces and a plurality of scans of lingual surfaces.

14. (Previously Presented) The computer readable storage medium of claim 12, wherein the plurality of image frames of the occlusal surface from the scan of the at least one additional surface each overlap with the contiguous scan of the occlusal surface,

wherein the plurality of image frames of the at least one additional surface includes image frames of a labial or lingual surface, and

wherein the code, when executed by the processor, causes the system to use the plurality of image frames of the occlusal surface that is included in the scan of the at least one additional surface to determine a position of the image frames of the labial or lingual surface relative to the contiguous scan of the occlusal surface.

15. (Previously Presented) The computer readable storage medium of claim 13, wherein the occlusal surface is imaged prior to the plurality of labial and lingual surfaces, and wherein the code, when executed by the processor, causes the system to display in real-time a three-dimensional representation of the dentition as the plurality of labial and lingual surfaces are imaged.

16. (Previously Presented) The computer readable storage medium of claim 15, wherein the code, when executed by the processor, causes the system to display in real-time the three-dimensional representation of the dentition by performing a coarse matching by matching features as the plurality of labial and lingual surfaces are imaged, and

wherein the code, when executed by the processor, further causes the system to generate a three-dimensional reconstruction of the dentition based on a point cloud alignment after the plurality of labial and lingual surfaces are all imaged.

17. (Previously Presented) The computer readable storage medium of claim 12, wherein the code, when executed by the processor, further causes the system to generate an occlusal

backbone by matching selected frames of the contiguous scan of the occlusal surface that have an overlap based on an analysis of data.

18. (Previously Presented) The computer readable storage medium of claim 17, wherein the code, when executed by the processor, further causes the system to detect the overlap based on noise characteristics of the data.

19. (Previously Presented) The computer readable storage medium of claim 17, wherein the occlusal backbone is a first occlusal backbone, and wherein the code, when executed by the processor, further causes the system to generate a second occlusal backbone that is more accurate than the first occlusal backbone by linking other frames that are different from the selected frames to the first occlusal backbone.

20. (Previously Presented) The computer readable storage medium of claim 19, wherein the code, when executed by the processor, further causes the system to generate a third occlusal backbone by removing, from the second occlusal backbone, areas representing at least one selected from a group consisting of a tongue, a cheek, and a lip.

21. (Previously Presented) The computer readable storage medium of claim 20, wherein the code, when executed by the processor, causes the system to remove the areas representing the at least one selected from the group consisting of the tongue, the cheek, and the lip based on differences in surface normal, color, or rigidity properties.

22-25. (Cancelled)

REMARKS

In the Restriction Requirement, the Examiner argues that the claims are directed to two patentably distinct species:

Species I including claims 1-7 and 11-21; and

Species II including claims 8-10 and 25.

The Applicant hereby elects Species I for further examination on the merits. Accordingly, by this Amendment, claims 8-10 and 25 have been cancelled. After entry of this Amendment, claims 1-7 and 11-21 remain pending. The Applicant reserves the right to file one or more divisional applications directed to the subject matter of cancelled claims 8-10 and 25.

In view of the above and in view of the remarks presented in the Applicant's response to the previous Office action, the Applicant submits that the application is in condition for allowance. The Applicant respectfully requests entry of this Amendment and allowance of claims 1-7 and 11-21. The undersigned is available for telephone consultation at the number below during normal business hours.

Respectfully submitted,

/andrew.j.paprocki/

Andrew J. Paprocki
Reg. No. 60,308

File No. 208764-9006-US02
Michael Best & Friedrich LLP
790 N. Water Street, Ste. 2500
Milwaukee, Wisconsin 53202
414-225-4947

PTO/AIA/22 (03-13)
Approved for use through 7/31/2016. OMB 0651-0031
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

PETITION FOR EXTENSION OF TIME UNDER 37 CFR 1.136(a)	Docket Number (Optional) 208764-9006-US02
Application Number 16/160,230	Filed October 15, 2018
For SCANNING SEQUENCE FOR AN INTRA-ORAL IMAGING SYSTEM	
Art Unit 2663	Examiner Vikkram Bali

This is a request under the provisions of 37 CFR 1.136(a) to extend the period for filing a reply in the above-identified application.

The requested extension and fee are as follows (check time period desired and enter the appropriate fee below):

	Fee	Small Entity Fee	Micro Entity Fee	
☐ One month (37 CFR 1.17(a)(1))	$200	$100	$50	$
☑ Two months (37 CFR 1.17(a)(2))	$600	$300	$150	$ 600
☐ Three months (37 CFR 1.17(a)(3))	$1,400	$700	$350	$
☐ Four months (37 CFR 1.17(a)(4))	$2,200	$1,100	$550	$
☐ Five months (37 CFR 1.17(a)(5))	$3,000	$1,500	$750	$

☐ Applicant asserts small entity status. See 37 CFR 1.27.

☐ Applicant certifies micro entity status. See 37 CFR 1.29.
Form PTO/SB/15A or B or equivalent must either be enclosed or have been submitted previously.

☐ A check in the amount of the fee is enclosed.

☐ Payment by credit card. Form PTO-2038 is attached.

☐ The Director has already been authorized to charge fees in this application to a Deposit Account.

☑ The Director is hereby authorized to charge any fees which may be required, or credit any overpayment, to Deposit Account Number 13-3080.

☑ Payment made via EFS-Web.

WARNING: Information on this form may become public. Credit card information should not be included on this form. Provide credit card information and authorization on PTO-2038.

I am the

☐ applicant.

☑ attorney or agent of record. Registration number 60,308.

☐ attorney or agent acting under 37 CFR 1.34. Registration number _____.

/andrew j. paprocki/ — Signature

September 18, 2020 — Date

Andrew J. Paprocki — Typed or printed name

414-271-6560 — Telephone Number

NOTE: This form must be signed in accordance with 37 CFR 1.33. See 37 CFR 1.4 for signature requirements and certifications. Submit multiple forms if more than one signature is required, see below*.

☑ * Total of 1 forms are submitted.

This collection of information is required by 37 CFR 1.136(a). The information is required to obtain or retain a benefit by the public, which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 6 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Mail Stop PCT, Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.

Electronic Patent Application Fee Transmittal

Application Number:	16160230
Filing Date:	15-Oct-2018
Title of Invention:	SCANNING SEQUENCE FOR AN INTRA-ORAL IMAGING SYSTEM
First Named Inventor/Applicant Name:	Robert F. Dillon
Filer:	Andrew J. Paprocki/Elizabeth Tressler
Attorney Docket Number:	208764-9006-US02

Filed as Large Entity

Filing Fees for Utility under 35 USC 111(a)

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
Pages:				
Claims:				
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				
Extension-of-Time:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Extension - 2 months with $0 paid	1252	1	600	600
Miscellaneous:				
			Total in USD ($)	**600**

Electronic Acknowledgement Receipt

EFS ID:	40598802
Application Number:	16160230
International Application Number:	
Confirmation Number:	8509
Title of Invention:	SCANNING SEQUENCE FOR AN INTRA-ORAL IMAGING SYSTEM
First Named Inventor/Applicant Name:	Robert F. Dillon
Customer Number:	129916
Filer:	Andrew J. Paprocki/Elizabeth Tressler
Filer Authorized By:	Andrew J. Paprocki
Attorney Docket Number:	208764-9006-US02
Receipt Date:	18-SEP-2020
Filing Date:	15-OCT-2018
Time Stamp:	12:45:22
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	CARD
Payment was successfully received in RAM	$600
RAM confirmation Number	E20209HC45442936
Deposit Account	133080
Authorized User	Elizabeth Tressler

The Director of the USPTO is hereby authorized to charge indicated fees and credit any overpayment as follows:

37 CFR 1.21 (Miscellaneous fees and charges)

37 CFR 1.20 (Post Issuance fees)

37 CFR 1.19 (Document supply fees)

37 CFR 1.17 (Patent application and reexamination processing fees)

37 CFR 1.16 (National application filing, search, and examination fees)

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1		208764-9006-US02_Response_to_RR_filed_9-18-2020.pdf	110092 f87720e57d04d44ea3435d68d3157c296a789b4e	yes	8

Multipart Description/PDF files in .zip description		
Document Description	**Start**	**End**
Response to Election / Restriction Filed	1	1
Claims	2	7
Applicant Arguments/Remarks Made in an Amendment	8	8

Warnings:					
Information:					
2	Extension of Time	208764-9006-US02_Extension_filed_9-18-2020.pdf	126268 a6b17f1ccc1ec7357c9cd3f2a3f2689a715ff1db	no	1
Warnings:					
Information:					
3	Fee Worksheet (SB06)	fee-info.pdf	31120 671bd6e2da45f4050513eb3de27467dbc0d6f074	no	2
Warnings:					
Information:					
		Total Files Size (in bytes):	267480		

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

PTO/SB/06 (09-11)
Approved for use through 1/31/2014. OMB 0651-0032
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it displays a valid OMB control number.

PATENT APPLICATION FEE DETERMINATION RECORD Substitute for Form PTO-875	Application or Docket Number 16/160,230	Filing Date 10/15/2018	☐ To be Mailed

ENTITY: ☑ LARGE ☐ SMALL ☐ MICRO

APPLICATION AS FILED - PART I

FOR	(Column 1) NUMBER FILED	(Column 2) NUMBER EXTRA		RATE ($)	FEE ($)
☐ BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A		N/A	
☐ SEARCH FEE (37 CFR 1.16(k), (i), or (m))	N/A	N/A		N/A	
☐ EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A		N/A	
TOTAL CLAIMS (37 CFR 1.16(i))	minus 20 =	*		x $100 =	
INDEPENDENT CLAIMS (37 CFR 1.16(h))	minus 3 =	*		x $460 =	
☐ APPLICATION SIZE FEE (37 CFR 1.16(s))	If the specification and drawings exceed 100 sheets of paper, the application size fee due is $310 ($155 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).				
☐ MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))					
* If the difference in column 1 is less than zero, enter "0" in column 2.				TOTAL	

APPLICATION AS AMENDED - PART II

		(Column 1)		(Column 2)	(Column 3)			
AMENDMENT	09/18/2020	CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA		RATE ($)	ADDITIONAL FEE ($)
	Total (37 CFR 1.16(i))	* 18	Minus	** 22	= 0		x $100 =	0
	Independent (37 CFR 1.16(h))	* 2	Minus	*** 3	= 0		x $460 =	0
	☐ Application Size Fee (37 CFR 1.16(s))							
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							
							TOTAL ADD'L FEE	0

		(Column 1)		(Column 2)	(Column 3)			
AMENDMENT		CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA		RATE ($)	ADDITIONAL FEE ($)
	Total (37 CFR 1.16(i))	*	Minus	**	=		x $0 =	
	Independent (37 CFR 1.16(h))	*	Minus	***	=		x $0 =	
	☐ Application Size Fee (37 CFR 1.16(s))							
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							
							TOTAL ADD'L FEE	

* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.	LIE
** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20".	/MARTHA A NEWMAN/
*** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3".	
The "Highest Number Previously Paid For" (Total or Independent) is the highest number found in the appropriate box in column 1.	

This collection of information is required by 37 CFR 1.16. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
16/160,230	10/15/2018	Robert F. Dillon	208764-9006-US02	8509

129916 7590 05/27/2020

Michael Best & Friedrich LLP (DITC)
790 N WATER ST
SUITE 2500
MILWAUKEE, WI 53202

EXAMINER	
BALI, VIKKRAM	

ART UNIT	PAPER NUMBER
2663	

NOTIFICATION DATE	DELIVERY MODE
05/27/2020	ELECTRONIC

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

mkeipdocket@michaelbest.com

Office Action Summary	Application No. 16/160,230	Applicant(s) Dillon et al.	
	Examiner VIKKRAM BALI	Art Unit 2663	AIA (FITF) Status No

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 2 MONTHS FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☐ Responsive to communication(s) filed on _____.

☐ A declaration(s)/affidavit(s) under **37 CFR 1.130(b)** was/were filed on _____.

2a)☐ This action is **FINAL.** 2b) ☐ This action is non-final.

3)☐ An election was made by the applicant in response to a restriction requirement set forth during the interview on _____; the restriction requirement and election have been incorporated into this action.

4)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims*

5) ☑ Claim(s) 1-21 and 25 is/are pending in the application.

5a) Of the above claim(s) _____ is/are withdrawn from consideration.

6) ☐ Claim(s) _____ is/are allowed.

7) ☐ Claim(s) _____ is/are rejected.

8) ☐ Claim(s) _____ is/are objected to.

9) ☑ Claim(s) 1-21 and 25 are subject to restriction and/or election requirement

* If any claims have been determined allowable, you may be eligible to benefit from the **Patent Prosecution Highway** program at a participating intellectual property office for the corresponding application. For more information, please see http://www.uspto.gov/patents/init_events/pph/index.jsp or send an inquiry to **PPHfeedback@uspto.gov.**

Application Papers

10)☐ The specification is objected to by the Examiner.

11)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

Certified copies:

a)☐ All b)☐ Some** c)☐ None of the:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

** See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)

2) ☐ Information Disclosure Statement(s) (PTO/SB/08a and/or PTO/SB/08b) Paper No(s)/Mail Date _____.

3) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date _____.

4) ☐ Other: _____.

DETAILED ACTION

Notice of Pre-AIA or AIA Status

1. The present application is being examined under the pre-AIA first to invent provisions.

Election/Restrictions

2. This application contains claims directed to the following patentably distinct species I claims 1-7, 11 and 12-21; species II claims 8-10 and 25. The species are independent or distinct because species II require a limitation of the first subset of image frames overlaps with an adjacent frame in the first subset of image frames by a defined percentage, generating of first phase and second phase of occlusal backbone which is not require by the species I. In addition, these species are not obvious variants of each other based on the current record.

Applicant is required under 35 U.S.C. 121 to elect a single disclosed species, or a single grouping of patentably indistinct species, for prosecution on the merits to which the claims shall be restricted if no generic claim is finally held to be allowable. Currently, there are no generic claim.

There is a search and/or examination burden for the patentably distinct species as set forth above because at least the following reason(s) apply:

(a) the inventions have acquired a separate status in the art in view of their different classification;

(b) the inventions have acquired a separate status in the art due to their recognized divergent subject matter;

(c) the inventions require a different field of search (for example, searching different classes/subclasses or electronic resources, or employing different search queries);

(d) the prior art applicable to one invention would not likely be applicable to another invention;

(e) the inventions are likely to raise different non-prior art issues under 35 U.S.C. 101 and/or 35 U.S.C. 112, first paragraph.

Applicant is advised that the reply to this requirement to be complete must include (i) an election of a species to be examined even though the requirement may be traversed (37 CFR 1.143) **and (ii) identification of the claims encompassing the elected species or grouping of patentably indistinct species**, including any claims subsequently added. An argument that a claim is allowable or that all claims are generic is considered nonresponsive unless accompanied by an election.

The election may be made with or without traverse. To preserve a right to petition, the election must be made with traverse. If the reply does not distinctly and specifically point out supposed errors in the election of species requirement, the election shall be treated as an election without traverse. Traversal must be presented at the time of election in order to be considered timely. Failure to timely traverse the requirement will result in the loss of right to petition under 37 CFR 1.144. If claims are added after the election, applicant must indicate which of these claims are readable on the elected species or grouping of patentably indistinct species.

Should applicant traverse on the ground that the species, or groupings of patentably indistinct species from which election is required, are not patentably distinct, applicant should

submit evidence or identify such evidence now of record showing them to be obvious variants or clearly admit on the record that this is the case. In either instance, if the examiner finds one of the species unpatentable over the prior art, the evidence or admission may be used in a rejection under 35 U.S.C. 103 or pre-AIA 35 U.S.C. 103(a) of the other species.

Upon the allowance of a generic claim, applicant will be entitled to consideration of claims to additional species which depend from or otherwise require all the limitations of an allowable generic claim as provided by 37 CFR 1.141.

3. A telephone call was made to Andrew Paprocki, Reg. # 60,308 on 5/20/2020 to request an oral election to the above restriction requirement, but did not result in an election being made as he ask for written restriction to be mailed.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to VIKKRAM BALI whose telephone number is (571)272-7415. The examiner can normally be reached on Monday-Friday 7:00AM-3:00PM.

Examiner interviews are available via telephone, in-person, and video conferencing using a USPTO supplied web-based collaboration tool. To schedule an interview, applicant is encouraged to use the USPTO Automated Interview Request (AIR) at http://www.uspto.gov/interviewpractice.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Dwayne Bost can be reached on 571-272-7023. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see https://ppair-my.uspto.gov/pair/PrivatePair. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/VIKKRAM BALI/
Primary Examiner, Art Unit 2663

Index of Claims	Application/Control No.	Applicant(s)/Patent Under Reexamination
	16/160,230	Dillon et al.
	Examiner	Art Unit
	VIKKRAM BALI	2663

✓	Rejected	-	Cancelled	N	Non-Elected	A	Appeal
=	Allowed	÷	Restricted	I	Interference	O	Objected

CLAIMS

☐ Claims renumbered in the same order as presented by applicant ☐ CPA ☐ T.D. ☐ R.1.47

CLAIM		DATE								
Final	Original	04/12/2019	09/05/2019	05/21/2020						
	1	✓	✓	÷						
	2	✓	✓	÷						
	3	✓	✓	÷						
	4	✓	✓	÷						
	5	✓	✓	÷						
	6	✓	✓	÷						
	7	✓	✓	÷						
	8	✓	✓	÷						
	9	✓	✓	÷						
	10	✓	✓	÷						
	11	✓	✓	÷						
	12	✓	✓	÷						
	13	✓	✓	÷						
	14	✓	✓	÷						
	15	✓	✓	÷						
	16	✓	✓	÷						
	17	✓	✓	÷						
	18	✓	✓	÷						
	19	✓	✓	÷						
	20	✓	✓	÷						
	21	✓	✓	÷						
	22	✓	-	-						
	23	✓	-	-						
	24	✓	-	-						
	25			÷						



United States Patent and Trademark Office

Office of the Chief Financial Officer

Document Code:WFEE

User :68630

Sale Accounting Date:03/13/2020

Sale Item Reference Number	Effective Date
16160230	03/11/2020

Document Number	Fee Code	Fee Code Description	Amount Paid	Payment Method
I20203C920069882	1202	CLAIMS IN EXCESS OF 20	$100.00	Deposit Account

PTO/SB/30EFS (02-18)
Approved for use through 11/30/2020. OMB 0651-0031
U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
Under the Paperwork Reduction Act of 1995, no persons are required to respond to a collection of information unless it contains a valid OMB control number.

REQUEST FOR CONTINUED EXAMINATION(RCE)TRANSMITTAL
(Submitted Only via EFS-Web)

Application Number	16160230	Filing Date	2018-10-15	Docket Number (if applicable)	208764-9006-US02	Art Unit	2663
First Named Inventor	Robert F. Dillon			Examiner Name	Vikkram Bali		

This is a Request for Continued Examination (RCE) under 37 CFR 1.114 of the above-identified application.
Request for Continued Examination (RCE) practice under 37 CFR 1.114 does not apply to any utility or plant application filed prior to June 8, 1995, or to any design application. The Instruction Sheet for this form is located at WWW.USPTO.GOV

SUBMISSION REQUIRED UNDER 37 CFR 1.114

Note: If the RCE is proper, any previously filed unentered amendments and amendments enclosed with the RCE will be entered in the order in which they were filed unless applicant instructs otherwise. If applicant does not wish to have any previously filed unentered amendment(s) entered, applicant must request non-entry of such amendment(s).

☐ Previously submitted. If a final Office action is outstanding, any amendments filed after the final Office action may be considered as a submission even if this box is not checked.

- ☐ Consider the arguments in the Appeal Brief or Reply Brief previously filed on _____
- ☐ Other _____

☒ Enclosed

- ☒ Amendment/Reply
- ☐ Information Disclosure Statement (IDS)
- ☐ Affidavit(s)/ Declaration(s)
- ☐ Other _____

MISCELLANEOUS

☐ Suspension of action on the above-identified application is requested under 37 CFR 1.103(c) for a period of months _____ (Period of suspension shall not exceed 3 months; Fee under 37 CFR 1.17(i) required)

☐ Other _____

FEES

☒ **The RCE fee under 37 CFR 1.17(e) is required by 37 CFR 1.114 when the RCE is filed.**
The Director is hereby authorized to charge any underpayment of fees, or credit any overpayments, to Deposit Account No 133080

SIGNATURE OF APPLICANT, ATTORNEY, OR AGENT REQUIRED

☒ Patent Practitioner Signature

Applicant Signature

PTO/SB/30EFS (02-18)
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Signature of Registered U.S. Patent Practitioner			
Signature	/andrew.j.paprocki/	Date (YYYY-MM-DD)	2020-03-11
Name	Andrew J. Paprocki	Registration Number	60308

This collection of information is required by 37 CFR 1.114. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450.

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

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The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

1. The information on this form will be treated confidentially to the extent allowed under the Freedom of Information Act (5 U.S.C. 552) and the Privacy Act (5 U.S.C. 552a). Records from this system of records may be disclosed to the Department of Justice to determine whether the Freedom of Information Act requires disclosure of these records.

2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.

3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.

4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).

5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.

6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).

7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.

8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspections or an issued patent.

9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
Group Art Unit 2663

In re

Patent Application of

Robert F. Dillon *et al.*

Application No. 16/160,230

Confirmation No.: 8509

Filed: October 15, 2018

Examiner: Vikkram Bali

"SCANNING SEQUENCE FOR AN INTRA-ORAL IMAGING SYSTEM"

Atty. Docket No. 208764-9006-US02

AMENDMENT AND RESPONSE TO OFFICE ACTION

Mail Stop Amendment
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

This communication is in response to the final Office action mailed September 11, 2019 and is filed with a request for a three-month extension of the period for reply and with a Request for Continued Examination (RCE). Please charge or credit Deposit Account No. 13-3080 with any shortage or overpayment of the fees associated with this communication.

Amendments to the Claims begin on page 2 of this paper.

Remarks begin on page 10 of this paper.

AMENDMENTS TO THE CLAIMS:

This listing of claims will replace all prior versions, and listings, of claims in the application:

1. (Currently Amended) A system for generating an intra-oral scan of a dentition, the system comprising:

a memory; and

a processor coupled to the memory, wherein the processor is configured to:

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

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

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

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

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

2. (Currently Amended) The system of claim 1, wherein the processor is further configured to associate a plurality of scans of additional surfaces to the contiguous scan of the

occlusal surface, wherein the plurality of scans ~~scan~~ of the ~~at least one~~ additional surfaces ~~surface comprises~~ includes a plurality of scans of labial surfaces and a plurality of scans of lingual surfaces.

3. (Currently Amended) The system of claim 1 ~~claim 2~~, wherein ~~each scan of a labial or lingual surface includes a part of~~ the plurality of image frames of the occlusal surface from the scan of the at least one additional surface each overlap with the contiguous scan of the occlusal surface,

wherein the plurality of images frames of the at least on additional surface includes image frames of a labial or lingual surface, and

wherein the processor is configured to use the plurality of image frames ~~part~~ of the occlusal surface that is included in ~~each~~ the scan of the at least one additional ~~labial or lingual~~ surface to ~~associate~~ determine a position of the image frames of the labial or lingual surface relative to the contiguous scan of the occlusal surface.

4. (Previously Presented) The system of claim 2, wherein the occlusal surface is imaged prior to the plurality of labial and lingual surfaces, and wherein the processor is further configured to display in real-time a three-dimensional representation of the dentition as the plurality of labial and lingual surfaces are imaged.

5. (Previously Presented) The system of claim 4, wherein the processor is configured to display in real-time the three-dimensional representation of the dentition by performing a coarse matching by matching features as the plurality of labial and lingual surfaces are imaged, and

wherein the processor is further configured to generate a three-dimensional reconstruction of the dentition based on a point cloud alignment after the plurality of labial and lingual surfaces are all imaged.

6. (Previously Presented) The system of claim 1, wherein the processor is further configured to generate an occlusal backbone by matching selected frames of the contiguous scan of the occlusal surface that have an overlap based on an analysis of data.

7. (Previously Presented) The system of claim 6, wherein the processor is configured to detect the overlap based on noise characteristics of the data.

8. (Currently Amended) ~~The~~ A system for generating an intra-oral scan of a dentition ~~of claim 6~~, the system comprising a processor configured to:

capture image data from a contiguous scan of an occlusal surface of at least a part of one arch of the dentition;

identify a first subset of image frames from the contiguous scan of the occlusal surface, wherein each frame in the first subset of image frames overlaps with an adjacent frame in the first subset of image frames by a defined percentage;

generate ~~wherein the occlusal backbone is~~ a first phase occlusal backbone, wherein the first phase occlusal backbone is a 3D model of the occlusal surface generated based only on the first subset of image frames; ~~and wherein the processor is further configured to~~

generate a second phase occlusal backbone that is more accurate than the first phase occlusal backbone by linking other image frames from the contiguous scan of

the occlusal surface that are not included in the first subset of image frame ~~different from the selected frames~~ to the first phase occlusal backbone;

capture image data from a scan of at least one additional surface, wherein the image data includes image frames of a surface of the dentition other than the occlusal surface;

analyzing the image data from the scan of the at least one additional surface to identify one or more image frames from the scan of the at least one additional surface that overlap with a portion of the contiguous scan of the occlusal surface; and

generating a 3D model of the dentition by determining a position of the image data from the scan of the at least one additional surface relative to the second phase occlusal backbone based on the identified overlap.

9. (Previously Presented) The system of claim 8, wherein the processor is further configured to generate a third occlusal backbone by removing, from the second occlusal backbone, areas representing at least one selected from a group consisting of a tongue, a cheek, and a lip.

10. (Previously Presented) The system of claim 9, wherein the processor is configured to remove the areas representing the at least one selected from the group consisting of the tongue, the cheek, and the lip based on differences in surface normal, color, or rigidity properties.

11. (Previously Presented) The system of claim 1, further comprising:

a projector that projects interferometric fringes on an occlusal surface of at least a part of one arch of the dentition primarily along an anterior-posterior direction; and

an imaging sensor that is used to view the interferometric fringes,

wherein the processor is further configured to generate the contiguous scan of the occlusal surface based on the interferometric fringes sensed by the imaging sensor.

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

generate a contiguous scan of an occlusal surface of at least a part of one arch of the dentition; and

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

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

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

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

13. (Currently Amended) The computer readable storage medium of claim 12, wherein the code, when executed by the processor, further causes the system to associate a plurality of scans of additional surfaces to the contiguous scan of the occlusal surface, wherein the plurality of scans ~~the scan~~ of the ~~at least one~~ additional ~~surface comprises~~ surfaces includes a plurality of scans of labial surfaces and a plurality of scans of lingual surfaces.

14. (Currently Amended) The computer readable storage medium of claim 12 ~~claim 13~~, wherein ~~each scan of a labial or lingual surface includes a part of~~ the plurality of image frames of the occlusal surface from the scan of the at least one additional surface each overlap with the contiguous scan of the occlusal surface,

wherein the plurality of image frames of the at least one additional surface includes image frames of a labial or lingual surface, and

wherein the code, when executed by the processor, causes the system to use the ~~part~~ plurality of image frames of the occlusal surface that is included in ~~each~~ the scan of the ~~labial or lingual~~ at least one additional surface to ~~associate~~ determine a position of the image frames of the labial or lingual surface relative to the contiguous scan of the occlusal surface.

15. (Previously Presented) The computer readable storage medium of claim 13, wherein the occlusal surface is imaged prior to the plurality of labial and lingual surfaces, and wherein the code, when executed by the processor, causes the system to display in real-time a three-dimensional representation of the dentition as the plurality of labial and lingual surfaces are imaged.

16. (Previously Presented) The computer readable storage medium of claim 15, wherein the code, when executed by the processor, causes the system to display in real-time the three-dimensional representation of the dentition by performing a coarse matching by matching features as the plurality of labial and lingual surfaces are imaged, and

wherein the code, when executed by the processor, further causes the system to generate a three-dimensional reconstruction of the dentition based on a point cloud alignment after the plurality of labial and lingual surfaces are all imaged.

17. (Previously Presented) The computer readable storage medium of claim 12, wherein the code, when executed by the processor, further causes the system to generate an occlusal backbone by matching selected frames of the contiguous scan of the occlusal surface that have an overlap based on an analysis of data.

18. (Previously Presented) The computer readable storage medium of claim 17, wherein the code, when executed by the processor, further causes the system to detect the overlap based on noise characteristics of the data.

19. (Previously Presented) The computer readable storage medium of claim 17, wherein the occlusal backbone is a first occlusal backbone, and wherein the code, when executed by the processor, further causes the system to generate a second occlusal backbone that is more accurate than the first occlusal backbone by linking other frames that are different from the selected frames to the first occlusal backbone.

20. (Previously Presented) The computer readable storage medium of claim 19, wherein the code, when executed by the processor, further causes the system to generate a third

occlusal backbone by removing, from the second occlusal backbone, areas representing at least one selected from a group consisting of a tongue, a cheek, and a lip.

21. (Previously Presented) The computer readable storage medium of claim 20, wherein the code, when executed by the processor, causes the system to remove the areas representing the at least one selected from the group consisting of the tongue, the cheek, and the lip based on differences in surface normal, color, or rigidity properties.

22-24. (Cancelled)

25. (New) The system of claim 8, wherein the processor if further configured to generate a third phase occlusal backbone that is more accurate than the second phase occlusal backbone by linking image frames of the occlusal surface from the scan of the at least one additional surface to the second phase occlusal backbone.

REMARKS

By this Amendment, claims 1-3, 8, and 12-14 have been amended and new claim 25 has been added. After entry of this Amendment, claims 1-21 and 25 remain pending.

Claims 1-8 and 11-19 stand rejected under 35 U.S.C. § 103 as being unpatentable over U.S. Publication No. 2004/0265770 to Chapoulaud et al. (hereinafter, "Chapoulaud") in view of U.S. Publication No. 2012/0062557 to Dillon et al. (hereinafter, "Dillon"). Claims 9, 10, 20, and 21 stand rejected under 35 U.S.C. § 103 as being unpatentable over Chapoulaud and Dillon in further view of U.S. Publication No. 2013/0218530 to Deichmann et al. (hereinafter, "Deichmann").

I. Independent Claims 1 and 12

In rejecting claim 1, the Examiner acknowledges that Chapoulaud fails to teach or suggest "associate[ing] a scan of at least one additional surface to the contiguous scan of the occlusal surface by analyzing the scan data to identify a portion of the scna of the at least one additional surface that overlaps with a portion of the contiguous scan of the occlusal surface, and determining a position of the scan of the at least one additional surface relative to the scan of the occlusal surface based on the identified overlapping portions" as required by independent claims 1 and 12. Instead, the Examiner argues that these specific limitations are all taught by Dillon in Figs. 4A through 4C and in paragraphs [0055] to [0056] (Office action, page 3).

Figs. 4A through 4C in Dillon show only the "labial" (i.e., front side) surface of the teeth and do not show any scan of an "occlusal surface" of dentition. However, paragraphs [0055] and [0056] describe an example of a method (illustrated in Fig. 6) in which two scans of the dentition are performed with an "overlap region" common to both scans. Dillon also suggests in paragraph [0055] that first of these two scans might include an "occlusal scan."

To clarify a distinction between the claimed invention and the teachings of Dillon, independent claims 1 and 12 have been amended to further recite: "wherein the scan of the at

least one additional surface includes a sequence of image frames including a plurality of image frames of the occlusal surface interspersed with a plurality of image frames of the at least one additional surface."

Although the Dillon publication appears to suggest that the image device be positioned at an "overlap region" at the beginning of a second scan so that the "FOV of the measurement device 12 registers . . . to the graphical representation of the 3D data in the overlap region in the display window," the Dillon publication does not teach or suggest a second scan (i.e., "a scan of at least one additional surface") in which image frames of the occlusal surface are interspersed with a plurality of image frames of the at least one additional surface.

For at least these reasons, Chapoulaud and Dillon, alone or in combination, fails to disclose or render obvious the subject matter defined by independent claim 1 or by independent claim 12. Therefore, claims 1 and 12 are allowable. Claims 2-7 & 11 and claims 13-21 depend from claims 1 and 12, respectively, and are allowable for the same reasons and also because they recite additional patentable subject matter.

II. Dependent Claim 5

Claim 5 recites in part: "wherein the processor is configured to

> display in real-time the three-dimensional representation of the dentition by preforming a coarse matching by matching features ***as the plurality of labial and lingual surfaces are imaged***, and . . .
>
> generate a three-dimensional reconstruction of the dentition based on a point cloud alignment ***after the plurality of labial and lingual surfaces are all imaged***."

In rejecting claim 5, the Examiner cites only to the Dillon publication as allegedly teaching the recited limitations. In particular, the Examiner cites paragraphs [0043] & [0046] of Dillon and Figs. 4B as evidence that Dillon teaches a "point cloud alignment."

However, regardless of whether or not Dillon teaches a "point cloud alignment," it fails to teach a system configured to use two different 3D reconstruction techniques as required by claim 5. Claim 5 specifically requires that the "coarse matching" be used to generate & display a three-dimensional representation of the dentition "as the plurality of labial and lingual surfaces are imaged" and using the point cloud alignment technique to generate a three-dimensional reconstruction "after the plurality of labial and lingual surfaces are all imaged." The Applicant's claimed system is configured to use the first technique to display a 3D model while additional image data is still being captured and uses the second technique to generate the 3D model after all of the image data has been captured.

The Examiner has failed to present any evidence to support a conclusion that the Applicant's claimed technique of using two different mechanism to generate 3D models would be obvious in view of the teachings of Chapoulaud and Dillon. The fact that Dillon may or may not use a "point cloud alignment" is irrelevant to this deficiency in the Examiner's argument. For at least these reasons, claim 5 is allowable.

III. Independent Claim 8 and Dependent Claim 25

By this Amendment, claim 8 has been amended into independent form to further highlight certain particular distinctions between the Applicant's claimed subject matter and the teachings of the cited references. In particular, independent claim 8, as amended, recites in part:

> "identify[ing] a first subset of image frames from the contiguous scan of the occlusal surface, wherein each frame in the first subset of image frames overlaps with an adjacent frame in the first subset of image frames by a defined percentage;
>
> "generat[ing] a first phase occlusal backbone, wherein the first phase occlusal backbone is a 3D model of the occlusal surface generated based only on the first subset of image frames; [and]

> "generating a second phase occlusal backbone that is more accurate than the first phase occlusal backbone by linking other image frames from the contiguous scan of the occlusal surface that are not included in the first subset of image frames to the first phase occlusal backbone."

An example of this process is illustrated in Fig. 7.

In dependent claim 25, the "occlusal backbone" is further refined as the additional scans of the lingual and labial surfaces are captured with interspersed image frames of the occlusal surface using the image frames of the occlusal surface from those additional scans. Therefore, according to dependent claim 25, the subsequent scans that includes image frames of the occlusal surface in addition to image data for the labial and lingual surfaces are used, not only to align the image data with the occlusal backbone, but also to improve the accuracy of the 3D modeling of the occlusal backbone.

In rejecting claim 8, the Examiner argues that Chapoulaud teaches both low and high resolution imaging and interprets this as "first and second occlusal backbone imaging" as claimed. However, Chapoulaud does not teach or suggest generating a first phase occlusal backbone and a second phase occlusal backbone using image frames from the same contiguous scan as required by claim 8.

For at least these reasons, Chapoulaud and Dillon, alone or in combination, fail to disclose or render obvious the subject matter defined by independent claim 8. Therefore, claim 8 is allowable. Claims 9, 10, and 25 depend from claim 8 and are allowable for the same reasons and also because they recite additional patentable subject matter.

CONCLUSION

In view of the above, Applicant submits that the application is in condition for allowance. The Applicant respectfully requests entry of this Amendment and allowance of claims 1-21 and 25. The undersigned is available for telephone consultation at the number below during normal business hours.

Respectfully submitted,

/andrew.j.paprocki/

Andrew J. Paprocki
Reg. No. 60,308

File No. 208764-9006-US02
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414-225-4947

PTO/AIA/22 (03-13)
Approved for use through 7/31/2016. OMB 0651-0031
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PETITION FOR EXTENSION OF TIME UNDER 37 CFR 1.136(a)	Docket Number (Optional) 208764-9006-US02
Application Number 16/160,230	Filed October 15, 2018
For SCANNING SEQUENCE FOR AN INTRA-ORAL IMAGING SYSTEM"	
Art Unit 2663	Examiner Vikkram Bali

This is a request under the provisions of 37 CFR 1.136(a) to extend the period for filing a reply in the above-identified application.

The requested extension and fee are as follows (check time period desired and enter the appropriate fee below):

		Fee	Small Entity Fee	Micro Entity Fee	
☐	One month (37 CFR 1.17(a)(1))	$200	$100	$50	$
☐	Two months (37 CFR 1.17(a)(2))	$600	$300	$150	$
☑	Three months (37 CFR 1.17(a)(3))	$1,400	$700	$350	$ 1,400
☐	Four months (37 CFR 1.17(a)(4))	$2,200	$1,100	$550	$
☐	Five months (37 CFR 1.17(a)(5))	$3,000	$1,500	$750	$

☐ Applicant asserts small entity status. See 37 CFR 1.27.

☐ Applicant certifies micro entity status. See 37 CFR 1.29.
Form PTO/SB/15A or B or equivalent must either be enclosed or have been submitted previously.

☐ A check in the amount of the fee is enclosed.

☐ Payment by credit card. Form PTO-2038 is attached.

☐ The Director has already been authorized to charge fees in this application to a Deposit Account.

☑ The Director is hereby authorized to charge any fees which may be required, or credit any overpayment, to Deposit Account Number 13-3080.

☑ Payment made via EFS-Web.

WARNING: Information on this form may become public. Credit card information should not be included on this form. Provide credit card information and authorization on PTO-2038.

I am the

☐ applicant.

☑ attorney or agent of record. Registration number 60,308.

☐ attorney or agent acting under 37 CFR 1.34. Registration number _____.

/andrew.j.paprocki/	March 11, 2020
Signature	Date
Andrew J. Paprocki	414-225-4947
Typed or printed name	Telephone Number

NOTE: This form must be signed in accordance with 37 CFR 1.33. See 37 CFR 1.4 for signature requirements and certifications. Submit multiple forms if more than one signature is required, see below*.

☑ * Total of 1 forms are submitted.

This collection of information is required by 37 CFR 1.136(a). The information is required to obtain or retain a benefit by the public, which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 6 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Mail Stop PCT, Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.

Electronic Patent Application Fee Transmittal

Application Number:	16160230
Filing Date:	15-Oct-2018
Title of Invention:	SCANNING SEQUENCE FOR AN INTRA-ORAL IMAGING SYSTEM
First Named Inventor/Applicant Name:	Robert F. Dillon
Filer:	Andrew J. Paprocki/Elizabeth Tressler
Attorney Docket Number:	208764-9006-US02

Filed as Large Entity

Filing Fees for Utility under 35 USC 111(a)

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
Pages:				
Claims:				
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				
Extension-of-Time:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Extension - 3 months with $0 paid	1253	1	1400	1400
Miscellaneous:				
RCE- 1ST REQUEST	1801	1	1300	1300
		Total in USD ($)		**2700**

Electronic Acknowledgement Receipt

EFS ID:	38833448
Application Number:	16160230
International Application Number:	
Confirmation Number:	8509
Title of Invention:	SCANNING SEQUENCE FOR AN INTRA-ORAL IMAGING SYSTEM
First Named Inventor/Applicant Name:	Robert F. Dillon
Customer Number:	129916
Filer:	Andrew J. Paprocki/Elizabeth Tressler
Filer Authorized By:	Andrew J. Paprocki
Attorney Docket Number:	208764-9006-US02
Receipt Date:	11-MAR-2020
Filing Date:	15-OCT-2018
Time Stamp:	15:31:17
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	CARD
Payment was successfully received in RAM	$2700
RAM confirmation Number	E20203AF31451213
Deposit Account	133080
Authorized User	Elizabeth Tressler

The Director of the USPTO is hereby authorized to charge indicated fees and credit any overpayment as follows:

37 CFR 1.16 (National application filing, search, and examination fees)

37 CFR 1.17 (Patent application and reexamination processing fees)

37 CFR 1.19 (Document supply fees)

37 CFR 1.20 (Post Issuance fees)

37 CFR 1.21 (Miscellaneous fees and charges)

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Request for Continued Examination (RCE)	208764-9006-US02_RCE_filed_3-11-2020.pdf	1349945 7a4595e2b9eac5a36ed2e94f575580c728540367	no	3
Warnings:					
Information:					
2		208764-9006-US02_Response_filed_3-11-2020.pdf	165392 eee09baafac25571261090562543812 4d376dd19	yes	14

Multipart Description/PDF files in .zip description

Document Description	Start	End
Amendment Submitted/Entered with Filing of CPA/RCE	1	1
Claims	2	9
Applicant Arguments/Remarks Made in an Amendment	10	14

Warnings:					
Information:					
3	Extension of Time	208764-9006-US02_Extension_filed_3-11-2020.pdf	127670 76075efec7e9a121ad96e8a3592d585dd3e93ace	no	1
Warnings:					
Information:					
4	Fee Worksheet (SB06)	fee-info.pdf	32650 eda5e0fc1ac0bfb2fb44e58bfaa7b68b76bddf87	no	2
Warnings:					
Information:					
		Total Files Size (in bytes):	1675657		

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New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

PTO/SB/06 (09-11)
Approved for use through 1/31/2014. OMB 0651-0032
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PATENT APPLICATION FEE DETERMINATION RECORD Substitute for Form PTO-875	Application or Docket Number 16/160,230	Filing Date 10/15/2018	☐ To be Mailed

ENTITY: ☑ LARGE ☐ SMALL ☐ MICRO

APPLICATION AS FILED - PART I

FOR	(Column 1) NUMBER FILED	(Column 2) NUMBER EXTRA		RATE ($)	FEE ($)
☐ BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A		N/A	
☐ SEARCH FEE (37 CFR 1.16(k), (i), or (m))	N/A	N/A		N/A	
☐ EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A		N/A	
TOTAL CLAIMS (37 CFR 1.16(i))	minus 20 =	*		x $100 =	
INDEPENDENT CLAIMS (37 CFR 1.16(h))	minus 3 =	*		x $460 =	
☐ APPLICATION SIZE FEE (37 CFR 1.16(s))	If the specification and drawings exceed 100 sheets of paper, the application size fee due is $310 ($155 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).				
☐ MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))					
* If the difference in column 1 is less than zero, enter "0" in column 2.				TOTAL	

APPLICATION AS AMENDED - PART II

		(Column 1)		(Column 2)	(Column 3)			
AMENDMENT	03/11/2020	CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA		RATE ($)	ADDITIONAL FEE ($)
	Total (37 CFR 1.16(i))	* 22	Minus	** 21	= 1		x $100 =	100
	Independent (37 CFR 1.16(h))	* 3	Minus	*** 3	= 0		x $460 =	0
	☐ Application Size Fee (37 CFR 1.16(s))							
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							
							TOTAL ADD'L FEE	100

		(Column 1)		(Column 2)	(Column 3)			
AMENDMENT		CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA		RATE ($)	ADDITIONAL FEE ($)
	Total (37 CFR 1.16(i))	*	Minus	**	=		x $0 =	
	Independent (37 CFR 1.16(h))	*	Minus	***	=		x $0 =	
	☐ Application Size Fee (37 CFR 1.16(s))							
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							
							TOTAL ADD'L FEE	

* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.	LIE
** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20".	/KIMBERLY N PANNELL/
*** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3".	
The "Highest Number Previously Paid For" (Total or Independent) is the highest number found in the appropriate box in column 1.	

This collection of information is required by 37 CFR 1.16. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
16/160,230	10/15/2018	Robert F. Dillon	208764-9006-US02	8509

129916 7590 09/11/2019

Michael Best & Friedrich LLP (DITC)
100 East Wisconsin Avenue
Suite 3300
Milwaukee, WI 53202

EXAMINER	
BALI, VIKKRAM	

ART UNIT	PAPER NUMBER
2663	

NOTIFICATION DATE	DELIVERY MODE
09/11/2019	ELECTRONIC

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

mkeipdocket@michaelbest.com

Office Action Summary	Application No. 16/160,230	Applicant(s) Dillon et al.	
	Examiner VIKKRAM BALI	Art Unit 2663	AIA (FITF) Status No

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTHS FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☑ Responsive to communication(s) filed on 8/12/2019.

☐ A declaration(s)/affidavit(s) under **37 CFR 1.130(b)** was/were filed on _____.

2a)☑ This action is **FINAL.** 2b) ☐ This action is non-final.

3)☐ An election was made by the applicant in response to a restriction requirement set forth during the interview on _____; the restriction requirement and election have been incorporated into this action.

4)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims*

5) ☑ Claim(s) 1-21 is/are pending in the application.

5a) Of the above claim(s) _____ is/are withdrawn from consideration.

6) ☐ Claim(s) _____ is/are allowed.

7) ☑ Claim(s) 1-21 is/are rejected.

8) ☐ Claim(s) _____ is/are objected to.

9) ☐ Claim(s) _____ are subject to restriction and/or election requirement

* If any claims have been determined allowable, you may be eligible to benefit from the **Patent Prosecution Highway** program at a participating intellectual property office for the corresponding application. For more information, please see http://www.uspto.gov/patents/init_events/pph/index.jsp or send an inquiry to **PPHfeedback@uspto.gov.**

Application Papers

10)☐ The specification is objected to by the Examiner.

11)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

Certified copies:

a)☐ All b)☐ Some** c)☐ None of the:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

** See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)

2) ☐ Information Disclosure Statement(s) (PTO/SB/08a and/or PTO/SB/08b) Paper No(s)/Mail Date _____.

3) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date _____.

4) ☐ Other: _____.

DETAILED ACTION

Notice of Pre-AIA or AIA Status

The present application is being examined under the pre-AIA first to invent provisions.

Response to Arguments

Applicant's arguments with respect to claims 1-4, 6, 12-15 and 17 have been considered but are moot because the arguments do not apply to any of the references being used in the current rejection.

Applicant's arguments filed with respect to claim 5 have been fully considered but they are not persuasive. Applicant argues that reference Dillon fails to disclose the feature of a "point cloud alignment", examiner respectfully disagrees, Dillon in paragraph 0046, states that the 3D representation is in point cloud, and in paragraph 0043, the figure 4B, is the display of the 3D point cloud, and figure 4B is the display of two scans put together i.e. aligned, therefore, the feature is taught in the reference, and the rejection stands.

Claim Rejections - 35 USC § 103

1. The following is a quotation of pre-AIA 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

2. Claims 1-8 and 11-19 are rejected under pre-AIA 35 U.S.C. 103(a) as being unpatentable over Chapoulaud et al (US 2004/0265770) in view of Dillon et al (US 2012/0062557).

With respect to claim 1, Chapoulaud discloses generating a scan of a dentition, the system comprising (see Abstract):

a memory; a processor coupled to the memory, wherein the processor is configured to (see figure 1):

generate a contiguous scan of an occlusal surface of at least a part of one arch of the dentition, (see figure 1, 3, 3A, 3B, and 4, and paragraph 0071) as claimed.

However, he fails to disclose associate a scan of at least one additional surface to the contiguous scan of the occlusal surface by analyzing the scan data to identify a portion of the scan of the at least one additional surface that overlaps with a portion of the contiguous scan of the occlusal surface, and determining a position of the scan of the at least one additional surface relative to the scan of the occlusal surface based on the identified overlapping portions, as claimed.

Dillon in the same field of art to generate an intra-oral scan of a dentition (see Abstract) teaches associate a scan of at least one additional surface to the contiguous scan of the occlusal surface by analyzing the scan data to identify a portion of the scan of the at least one additional surface that overlaps with a portion of the contiguous scan of the occlusal surface, and determining a position of the scan of the at least one additional surface relative to the scan of the occlusal surface based on the identified overlapping portions, (see figures 4A-4C, and paragraphs 0055-0056) as claimed.

Therefore, it would have been obvious to one ordinary skilled in the art at the time of invention to combine the two references as they are analogous because they are solving similar

problem of intra oral scanning. The teachings of Dillon of data display in real time using the 3D display can be incorporated into Chapoulaud's system for the ease of the system.

With respect to claim 2, combination of Chapoulaud and Dillon further discloses wherein the scan of the at least one additional surface comprises a plurality of scans of labial surfaces and a plurality of scans of lingual surfaces, (see Chapoulaud figure 4, and paragraph 0071) as claimed.

With respect to claim 3, combination of Chapoulaud and Dillon further discloses wherein each scan of a labial or lingual surface includes a part of the occlusal surface, and wherein the processor is configured to use the part of the occlusal surface that is included in each scan of the labial or lingual surface to associate the labial or lingual surface to the contiguous scan of the occlusal surface, (see Chapoulaud figure 4 and paragraph 0071) as claimed.

With respect to claim 4, combination of Chapoulaud and Dillon further discloses wherein the occlusal surface is imaged prior to the plurality of labial and lingual surfaces, and wherein the processor is further configured to display in real-time a three-dimensional representation of the dentition as the plurality of labial and lingual surfaces are imaged, (see Chapoulaud figure 4) as claimed.

With respect to claim 5, combination of Chapoulaud and Dillon further discloses wherein the processor is configured to display in real-time the three-dimensional representation of the dentition by performing a coarse matching by matching features as the plurality of labial and lingual surfaces are imaged, and wherein the processor is further configured to generate a three-dimensional reconstruction of the dentition based on a point cloud alignment after the plurality of labial and lingual surfaces are all imaged, (see Dillon in paragraph 0046, states that the 3D representation is in point cloud, and in paragraph 0043, the figure 4B, is the display of the 3D point cloud, and figure 4B is the display of two scans put together i.e. aligned), as claimed.

With respect to claim 6, combination of Chapoulaud and Dillon further discloses wherein the processor is further configured to generate an occlusal backbone by matching selected frames of the contiguous scan of the occlusal surface that have an overlap based on an analysis of data, (see Chapoulaud figure 3A, 3B, and 4, and paragraph 0071) as claimed.

With respect to claim 7, combination of Chapoulaud and Dillon further discloses wherein the processor is configured to detect the overlap based on noise characteristics of the data, (see Dillon paragraph 0037, right hand column last 6 lines, checking if the two displays are similar "noise characteristics") as claimed.

With respect to claim 8, combination of Chapoulaud and Dillon further discloses wherein the occlusal backbone is a first occlusal backbone, and wherein the processor is further configured to generate a second occlusal backbone that is more accurate than the first occlusal backbone by linking other frames that are different from the selected frames to the first occlusal backbone, (see Chapoulaud paragraph 0071, low and high resolution imaging is read as first and second occlusal backbone imaging) as claimed.

With respect to claim 11, combination of Chapoulaud and Dillon further discloses a projector that projects interferometric fringes on an occlusal surface of at least a part of one arch of the dentition primarily along an anterior-posterior direction; and an imaging sensor that is used to view the interferometric fringes, wherein the processor is further configured to generate the contiguous scan of the occlusal surface based on the interferometric fringes sensed by the imaging sensor, as claimed, (see Dillon figure 2, numerical 22, and paragraph 0028), as claimed.

Claims 12-15 and 17, are for the same reason as set forth in the rejections for claims 1-4 and 6, because claims 12-15 and 17 are claiming subject matter similar to the claimed subject in claims 1-4 and 6.

Claims 16, 18 and 19, are for the same reason as set forth in the rejections for claims 5, 7 and 8, because claims 16, 18 and 19 are claiming subject matter similar to the claimed subject in claims 5, 7 and 8.

3. Claims 9, 10, 20 and 21 are rejected under pre-AIA 35 U.S.C. 103(a) as being unpatentable over Chapoulaud et al (US 2004/0265770) in view of Dillon et al (US 2012/006257) as applied to claim 8 above, and further in view of Deichmann et al (US Pub. 2013/021853 0).

With respect to claims 9 and 10, Chapoulaud and Dillon discloses all the limitations as claimed in claim 8 and as rejected above. However, they fails to disclose wherein the processor is further configured to generate a third occlusal backbone by removing, from the second occlusal backbone, areas representing at least one selected from a group consisting of a tongue, a cheek, and a lip; and wherein the processor is configured to remove the areas representing the at least one selected from the group consisting of the tongue, the cheek, and the lip based on differences in surface normal, color, or rigidity properties, as claimed.

Deichmann in the same field teaches wherein the processor is further configured to generate a third occlusal backbone by removing, from the second occlusal backbone, areas representing at least one selected from a group consisting of a tongue, a cheek, and a lip; and wherein the processor is configured to remove the areas representing the at least one selected from the group consisting of the tongue, the cheek, and the lip based on differences in surface normal, color, or rigidity properties, (see paragraph 0101, wherein the a segmenting is performed to cutoff the lip and teeth image in order to get the image using a color difference) as claimed.

Therefore, it would have been obvious to one ordinary skilled in the art at the time of invention to combine the references as they are analogous because they are solving similar problem of intra oral scanning. The teachings of Deichmann of segmenting the image s to get

the clear image of teeth can be incorporated into Chapoulaud's and Dillon system to yield the clear imagery.

Claims 20 and 21, are for the same reason as set forth in the rejections for claims 9 and 10, because claims 20 and 21 are claiming subject matter similar to the claimed subject in claims 9 and 10.

Conclusion

THIS ACTION IS MADE FINAL. Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to VIKKRAM BALI whose telephone number is (571)272-7415. The examiner can normally be reached on Monday-Friday 7:00AM-3:00PM.

Examiner interviews are available via telephone, in-person, and video conferencing using a USPTO supplied web-based collaboration tool. To schedule an interview, applicant is encouraged to use the USPTO Automated Interview Request (AIR) at http://www.uspto.gov/interviewpractice.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Dwayne Bost can be reached on 571-272-7023. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/VIKKRAM BALI/
Primary Examiner, Art Unit 2663

Index of Claims	Application/Control No.	Applicant(s)/Patent Under Reexamination
	16/160,230	Dillon et al.
	Examiner	Art Unit
	VIKKRAM BALI	2663

✓	Rejected	-	Cancelled	N	Non-Elected	A	Appeal
=	Allowed	÷	Restricted	I	Interference	O	Objected

CLAIMS

☐ Claims renumbered in the same order as presented by applicant ☐ CPA ☐ T.D. ☐ R.1.47

CLAIM		DATE								
Final	Original	04/12/2019	09/05/2019							
	1	✓	✓							
	2	✓	✓							
	3	✓	✓							
	4	✓	✓							
	5	✓	✓							
	6	✓	✓							
	7	✓	✓							
	8	✓	✓							
	9	✓	✓							
	10	✓	✓							
	11	✓	✓							
	12	✓	✓							
	13	✓	✓							
	14	✓	✓							
	15	✓	✓							
	16	✓	✓							
	17	✓	✓							
	18	✓	✓							
	19	✓	✓							
	20	✓	✓							
	21	✓	✓							
	22	✓	-							
	23	✓	-							
	24	✓	-							

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	16/160,230	Dillon et al.
	Examiner	Art Unit
	VIKKRAM BALI	2663

CPC - Searched*		
Symbol	Date	Examiner

CPC Combination Sets - Searched*		
Symbol	Date	Examiner

US Classification - Searched*			
Class	Subclass	Date	Examiner

* See search history printout included with this form or the SEARCH NOTES box below to determine the scope of the search.

Search Notes		
Search Notes	Date	Examiner
Inventor name search	04/12/2019	vb
Limited text search in EAST and CPC - A61B$.CPC. A61C9$.CPC.	04/12/2019	vb
NPL search	04/12/2019	vb
Updated search	09/05/2019	vb

Interference Search			
US Class/CPC Symbol	US Subclass/CPC Group	Date	Examiner

EAST Search History

EAST Search History (Prior Art)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
L1	3	"20120062557".pn.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2019/09/05 07:55
L2	1	1 and (labial lingual cloud noise)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2019/09/05 07:56
S1	10	"9622834".pn. "9157733".pn. "20120062557".pn.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2017/06/12 11:07
S2	2	S1 and (oral and imag$4 and cavity and (wand handpiece) and occlusal)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2017/06/12 11:08
S3	150	(oral and imag$4 and cavity and (wand handpiece) and occlusal)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2017/06/12 11:13
S4	39	S3 and (lingual and labial)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2017/06/12 11:14
S5	719	ormco.asn.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2017/06/12 11:22
S6	2	S5 and (oral and imag$4 and cavity and (wand handpiece) and occlusal)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2017/06/12 11:22
S7	11	S5 and (oral and imag$4 and cavity and project$3)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2017/06/12 11:24
S8	5	S5 and (oral and imag$4 and cavity and project$3 and occlusal)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2017/06/12 11:28

S9	267	(dillon near robert).in.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2017/06/12 15:12
S10	218	(andreiko near craig).in.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2017/06/12 15:12
S11	12	(vesper near andrew).in.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2017/06/12 15:14
S12	178	(judell near neil).in.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2017/06/12 15:14
S13	41	(fillion near timothy).in.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2017/06/12 15:14
S14	598	S9 S10 S11 S12 S13	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2017/06/12 15:15
S15	13	S14 and (oral and imag$4 and cavity and project$3)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2017/06/12 15:18
S16	172337	A61B$.CPC. A61C9$.CPC.	USPAT	OR	OFF	2017/06/12 16:05
S17	580	(oral and imag$4 and cavity and (wand handpiece scan$4) and occlusal and project$4 and (teeth tooth))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2017/06/12 16:06
S18	153	S16 and S17	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2017/06/12 16:07
S19	1	(oral and imag$4 and cavity and (wand handpiece scan$4) and occlusal and project$4 and (teeth tooth)).clm.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2017/06/12 16:07
S20	1	"8390822".pn.	USPAT	OR	OFF	2017/06/13 09:07
S21	0	S20 and (occlusal)	USPAT	OR	OFF	2017/06/13 09:10
S22	10	"9622834".pn. "9157733".pn. "20120062557".pn.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO;	OR	OFF	2017/06/13 09:15

			DERWENT; IBM_TDB			
S23	17	(backbone bone (back adj2 bone)) near occlusal	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2018/04/23 12:02
S24	2	("2014/0272774").URPN.	USPAT	OR	ON	2018/04/23 12:04
S25	1	(oral and imag$4 and cavity and (wand handpiece scan$4) and occlusal and project$4 and (teeth tooth)).clm.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2018/06/14 13:56
S26	17	s22s	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2018/06/14 13:56
S27	10	"9622834".pn. "9157733".pn. "20120062557".pn.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2018/06/14 13:56
S28	10	S27	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2018/06/14 13:56
S29	18	(backbone bone (back adj2 bone)) near occlusal	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2018/06/14 13:56
S30	18	S29	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2018/06/14 13:56
S31	186805	A61B$.CPC. A61C9$.CPC.	USPAT	OR	OFF	2018/06/14 13:57
S32	675	(oral and imag$4 and cavity and (wand handpiece scan$4) and occlusal and project$4 and (teeth tooth))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2018/06/14 13:57
S33	187	S31 and S32	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2018/06/14 13:57
S34	187	S33	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2018/06/14 13:57
S35	199441	A61B$.CPC. A61C9$.CPC.	USPAT	OR	OFF	2019/04/12 08:25
S36	739	(oral and imag$4 and cavity and	US-PGPUB;	OR	OFF	2019/04/12

		(wand handpiece scan$4) and occlusal and project$4 and (teeth tooth))	USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB			08:25
S37	211	S35 and S36	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2019/04/12 08:25
S38	307	(dillon near robert).in.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2019/04/12 08:26
S39	236	(andreiko near craig).in.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2019/04/12 08:26
S40	17	(vesper near andrew).in.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2019/04/12 08:26
S41	193	(judell near neil).in.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2019/04/12 08:26
S42	50	(fillion near timothy).in.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2019/04/12 08:26
S43	657	S38 S39 S40 S41 S42	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2019/04/12 08:26
S44	17	S43 and (oral and imag$4 and cavity and project$3)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2019/04/12 08:26
S45	8	("20040265770" | "20050058962" | "20120062557" | "20120129119" | "6402707" | "7717708" | "7905725" | "8390822").PN.	US-PGPUB; USPAT	OR	ON	2019/04/12 09:56
S46	4	"6648640".pn. "7286954".pn.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2019/04/12 13:27
S47	5	"20120062557".pn. "20040265770".pn.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2019/04/12 13:30
S48	0	S47 and (cheek lip tongue)	US-PGPUB; USPAT; USOCR;	OR	OFF	2019/04/12 13:30

			FPRS; EPO; JPO; DERWENT; IBM_TDB			
S49	2	S47 and (color rigid$)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2019/04/12 13:31
S50	50	"s362" and (cheek lip tongue)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2019/04/12 14:16
S51	739	(oral and imag$4 and cavity and (wand handpiece scan$4) and occlusal and project$4 and (teeth tooth))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2019/04/12 14:16
S52	278	S51 and (cheek lip tongue)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2019/04/12 14:16
S53	50	S51 and ((segment$4 differenc$4 substract$4) same (cheek lip tongue))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2019/04/12 14:17
S54	35	S51 and ((segment$4 differenc$4 substract$4) same (tongue))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2019/04/12 14:27
S55	489	((segment$4 differenc$4 substract$4) same (tongue) same image)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2019/04/12 15:56
S56	7	S51 and S55	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2019/04/12 15:56
S57	1904	((segment$4 differenc$4 substract$4) same (cheek lip tongue) same image)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2019/04/12 15:58
S58	13	S51 and S57	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2019/04/12 15:59
S59	323	S57 and (occlusal teeth tooth dentit$3 jaw)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2019/04/12 16:14
S60	135	S57 same (occlusal teeth tooth dentit$3 jaw)	US-PGPUB; USPAT; USOCR;	OR	OFF	2019/04/12 16:14

			FPRS; EPO; JPO; DERWENT; IBM_TDB			

9/ 5/ 2019 12:31:18 PM
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PTO/SB/06 (09-11)
Approved for use through 1/31/2014. OMB 0651-0032
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PATENT APPLICATION FEE DETERMINATION RECORD Substitute for Form PTO-875	Application or Docket Number 16/160,230	Filing Date 10/15/2018	☐ To be Mailed

ENTITY: ☑ LARGE ☐ SMALL ☐ MICRO

APPLICATION AS FILED - PART I

FOR	(Column 1) NUMBER FILED	(Column 2) NUMBER EXTRA		RATE ($)	FEE ($)
☐ BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A		N/A	
☐ SEARCH FEE (37 CFR 1.16(k), (i), or (m))	N/A	N/A		N/A	
☐ EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A		N/A	
TOTAL CLAIMS (37 CFR 1.16(i))	minus 20 =	*		x $100 =	
INDEPENDENT CLAIMS (37 CFR 1.16(h))	minus 3 =	*		x $460 =	
☐ APPLICATION SIZE FEE (37 CFR 1.16(s))	If the specification and drawings exceed 100 sheets of paper, the application size fee due is $310 ($155 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).				
☐ MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))					
* If the difference in column 1 is less than zero, enter "0" in column 2.				TOTAL	

APPLICATION AS AMENDED - PART II

		(Column 1)		(Column 2)	(Column 3)			
AMENDMENT	08/12/2019	CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA		RATE ($)	ADDITIONAL FEE ($)
	Total (37 CFR 1.16(i))	* 21	Minus	** 20	= 1		x $100 =	100
	Independent (37 CFR 1.16(h))	* 2	Minus	*** 3	= 0		x $460 =	0
	☐ Application Size Fee (37 CFR 1.16(s))							
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							
							TOTAL ADD'L FEE	100

		(Column 1)		(Column 2)	(Column 3)			
AMENDMENT		CLAIMS REMAINING AFTER AMENDMENT		HIGHEST NUMBER PREVIOUSLY PAID FOR	PRESENT EXTRA		RATE ($)	ADDITIONAL FEE ($)
	Total (37 CFR 1.16(i))	*	Minus	**	=		x $0 =	
	Independent (37 CFR 1.16(h))	*	Minus	***	=		x $0 =	
	☐ Application Size Fee (37 CFR 1.16(s))							
	☐ FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							
							TOTAL ADD'L FEE	

* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.	LIE
** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20".	/MONICA D FRANCIS/
*** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3".	
The "Highest Number Previously Paid For" (Total or Independent) is the highest number found in the appropriate box in column 1.	

This collection of information is required by 37 CFR 1.16. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 12 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

If you need assistance in completing the form, call 1-800-PTO-9199 and select option 2.

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
Group Art Unit 2663

In re

Patent Application of

Robert F. Dillon *et al.*

Application No. 16/160,230

Confirmation No.: 8509

Filed: October 15, 2018

Examiner: Vikkram Bali

"SCANNING SEQUENCE FOR AN INTRA-ORAL IMAGING SYSTEM"

Atty. Docket No. 208764-9006-US02

AMENDMENT AND RESPONSE TO OFFICE ACTION

Mail Stop Amendment
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

This communication is in response to the non-final Office action mailed April 17, 2019 and is filed within the three-month period for reply. Please charge or credit Deposit Account No. 13-3080 with any shortage or overpayment of the fees associated with this communication.

Amendments to the Claims begin on page 2 of this paper.

Remarks begin on page 8 of this paper.

AMENDMENTS TO THE CLAIMS:

This listing of claims will replace all prior versions, and listings, of claims in the application:

1. (Currently Amended) A system for generating an intra-oral scan of a dentition, the system comprising:

a memory; and

a processor coupled to the memory, wherein the processor is configured to:

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

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

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

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

2. (Previously Presented) The system of claim 1, wherein the scan of the at least one additional surface comprises a plurality of scans of labial surfaces and a plurality of scans of lingual surfaces.

3. (Previously Presented) The system of claim 2, wherein each scan of a labial or lingual surface includes a part of the occlusal surface, and wherein the processor is configured to use the part of the occlusal surface that is included in each scan of the labial or lingual surface to associate the labial or lingual surface to the contiguous scan of the occlusal surface.

4. (Previously Presented) The system of claim 2, wherein the occlusal surface is imaged prior to the plurality of labial and lingual surfaces, and wherein the processor is further configured to display in real-time a three-dimensional representation of the dentition as the plurality of labial and lingual surfaces are imaged.

5. (Previously Presented) The system of claim 4, wherein the processor is configured to display in real-time the three-dimensional representation of the dentition by performing a coarse matching by matching features as the plurality of labial and lingual surfaces are imaged, and

wherein the processor is further configured to generate a three-dimensional reconstruction of the dentition based on a point cloud alignment after the plurality of labial and lingual surfaces are all imaged.

6. (Previously Presented) The system of claim 1, wherein the processor is further configured to generate an occlusal backbone by matching selected frames of the contiguous scan of the occlusal surface that have an overlap based on an analysis of data.

7. (Previously Presented) The system of claim 6, wherein the processor is configured to detect the overlap based on noise characteristics of the data.

8. (Previously Presented) The system of claim 6, wherein the occlusal backbone is a first occlusal backbone, and wherein the processor is further configured to generate a second occlusal backbone that is more accurate than the first occlusal backbone by linking other frames that are different from the selected frames to the first occlusal backbone.

9. (Previously Presented) The system of claim 8, wherein the processor is further configured to generate a third occlusal backbone by removing, from the second occlusal backbone, areas representing at least one selected from a group consisting of a tongue, a cheek, and a lip.

10. (Previously Presented) The system of claim 9, wherein the processor is configured to remove the areas representing the at least one selected from the group consisting of the tongue, the cheek, and the lip based on differences in surface normal, color, or rigidity properties.

11. (Previously Presented) The system of claim 1, further comprising:

a projector that projects interferometric fringes on an occlusal surface of at least a part of one arch of the dentition primarily along an anterior-posterior direction; and

an imaging sensor that is used to view the interferometric fringes,

wherein the processor is further configured to generate the contiguous scan of the occlusal surface based on the interferometric fringes sensed by the imaging sensor.

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

generate a contiguous scan of an occlusal surface of at least a part of one arch of the dentition; and

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

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

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

13. (Previously Presented) The computer readable storage medium of claim 12, wherein the scan of the at least one additional surface comprises a plurality of scans of labial surfaces and a plurality of scans of lingual surfaces.

14. (Previously Presented) The computer readable storage medium of claim 13, wherein each scan of a labial or lingual surface includes a part of the occlusal surface, and wherein the code, when executed by the processor, causes the system to use the part of the occlusal surface that is included in each scan of the labial or lingual surface to associate the labial or lingual surface to the contiguous scan of the occlusal surface.

15. (Previously Presented) The computer readable storage medium of claim 13, wherein the occlusal surface is imaged prior to the plurality of labial and lingual surfaces, and wherein the code, when executed by the processor, causes the system to display in real-time a three-dimensional representation of the dentition as the plurality of labial and lingual surfaces are imaged.

16. (Previously Presented) The computer readable storage medium of claim 15, wherein the code, when executed by the processor, causes the system to display in real-time the three-dimensional representation of the dentition by performing a coarse matching by matching features as the plurality of labial and lingual surfaces are imaged, and

wherein the code, when executed by the processor, further causes the system to generate a three-dimensional reconstruction of the dentition based on a point cloud alignment after the plurality of labial and lingual surfaces are all imaged.

17. (Previously Presented) The computer readable storage medium of claim 12, wherein the code, when executed by the processor, further causes the system to generate an occlusal backbone by matching selected frames of the contiguous scan of the occlusal surface that have an overlap based on an analysis of data.

18. (Previously Presented) The computer readable storage medium of claim 17, wherein the code, when executed by the processor, further causes the system to detect the overlap based on noise characteristics of the data.

19. (Previously Presented) The computer readable storage medium of claim 17, wherein the occlusal backbone is a first occlusal backbone, and wherein the code, when executed by the processor, further causes the system to generate a second occlusal backbone that is more accurate than the first occlusal backbone by linking other frames that are different from the selected frames to the first occlusal backbone.

20. (Previously Presented) The computer readable storage medium of claim 19, wherein the code, when executed by the processor, further causes the system to generate a third occlusal backbone by removing, from the second occlusal backbone, areas representing at least one selected from a group consisting of a tongue, a cheek, and a lip.

21. (Previously Presented) The computer readable storage medium of claim 20, wherein the code, when executed by the processor, causes the system to remove the areas representing the at least one selected from the group consisting of the tongue, the cheek, and the lip based on differences in surface normal, color, or rigidity properties.

22-24. (Cancelled)

REMARKS

By this Amendment, claims 1 and 12 have been amended and claims 22-24 have been cancelled. After entry of this Amendment, claims 1-21 remain pending.

Claims 1-4, 6, 12-15, and 17 stand rejected under 35 U.S.C. § 102 as being anticipated by U.S. Publication No. 2004/0265770 to Chapoulaud et al. (hereinafter, "Chapoulaud"). Claims 5, 7, 8, 11, 16, 18, 19, and 22-24 stand rejected under 35 U.S.C. § 103 as being unpatentable over Chapoulaud in view of U.S. Publication No. 2012/0062557 to Dillon et al. (hereinafter, "Dillon"). Claims 9, 10, 20, and 21 stand rejected under 35 U.S.C. § 103 as being unpatentable over Chapoulaud and Dillon in further view of U.S. Publication No. 2013/0218530 to Deichmann et al. (hereinafter, Deichmann).

First, independent claims 1 and 12 are directed towards mechanisms for generating an "intra-oral scan of a dentition." Chapoulaud describes a system for imaging a a model 20 of a patient's mouth (i.e., an impression molded cast). Accordingly, Chapoulaud does not teach or suggest mechanisms for "intra-oral" scanning of dentition.

Second, the pending claims recite mechanisms that receive/capture a contiguous scan of an occlusal surface, then receive one or more additional scans of other surfaces in the same dentition, and ultimately generates a digital three-dimensional reconstruction of the dentition by "associating" each scan of an additional surface to the contiguous scan of the occlusal surface. Independent claims 1 and 12 have been amended to recite further details of the mechanism by which the scans of the additional surfaces are "associated" with the occlusal scan. In particular, claims 1 and 12 now recite "analyzing scan data to identify a portion of the scan of the at least one additional surface that overlaps with a portion of the contiguous scan, and determining a position of the scan of the at least one additional surface relative to the scan of the occlusal surface based on the identified overlapping portions."

Chapoulaud does not teach or suggest determining a relative position of additional scans relative to the occlusal surface by identifying overlapping portions in the scan data. Instead, Chapoulaud teaches a system in which the cast model of the teeth are positioned in a holder. Not only does Chapoulaud not teach capturing multiple scans that partially overlap

with each other, but also, because Chapoulaud's system is configured to know the positioning of the optical scanner relative to the holder, it does not use or need any additional mechanism for identifying a position of one scan relative to another by analyzing the scan data.

For at least these reasons, Chapoulaud does not disclose the subject matter defined by independent claims 1 and 12. Therefore, claims 1 and 12 are allowable. Claims 2-11 and 13-21 depend from claims 1 and 12, respectively, and are allowable for the same reasons and because they recite additional patentable subject matter.

Finally, claim 5 recites a two-stage process implemented by the claimed system for generating and displaying three-dimensional digital models of a patient's dentition based on captured scan data. First, the system uses a "coarse matching" technique to add scan data to a "three-dimensional representation" of the dentition in real-time as each new additional scan is captured/received. Second, after all of the additional scans are completed, the system uses a "point cloud alignment" technique to generate a final "three-dimensional reconstruction" of the dentition based on all of the captured scans.

In rejecting claim 5, the Examiner concedes that these features are not taught by Chapoulaud, but argues that they are disclosed by Dillon and cites generally to paragraph [0046]. In paragraph [0046], Dillon teaches that 3D data generated from a measurement scan can be displayed "as a 3D point cloud." However, paragraph [0046] does not teach or suggest any specific mechanism by which a three-dimensional reconstruction is generated – it only mentions how the 3D data might be displayed. Furthermore, Dillon does not appear to specifically mention a "point cloud ***alignment***" technique anywhere. Dillon also does not appear to teach a two-stage process by which a first technique is used to match and display scan data as a three-dimensional representation in real time as the scan data is captured ***and*** then using a different technique for generating a three-dimensional reconstruction after all of the scans have been completed.

For at least these reasons, Dillon fails to disclose the subject matter defined by dependent claim 5 and, accordingly, does not & cannot cure the deficiencies of Chapoulaud with respect to claim 5. Therefore, claim 5 is allowable.

CONCLUSION

In view of the above, Applicant submits that the application is in condition for allowance. The Applicant respectfully requests entry of this Amendment and allowance of claims 1-21. The undersigned is available for telephone consultation at the number below during normal business hours.

Respectfully submitted,

/andrew.j.paprocki/

Andrew J. Paprocki
Reg. No. 60,308

File No. 208764-9006-US01
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414-225-4947

PTO/AIA/22 (03-13)
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PETITION FOR EXTENSION OF TIME UNDER 37 CFR 1.136(a)	Docket Number (Optional) 208764-9006-US02
Application Number 16/160,230	Filed October 15, 2018
For SCANNING SEQUENCE FOR AN INTRA-ORAL IMAGING SYSTEM"	
Art Unit 2663	Examiner Vikkram Bali

This is a request under the provisions of 37 CFR 1.136(a) to extend the period for filing a reply in the above-identified application.

The requested extension and fee are as follows (check time period desired and enter the appropriate fee below):

		Fee	Small Entity Fee	Micro Entity Fee	
☑	One month (37 CFR 1.17(a)(1))	$200	$100	$50	$ 200
☐	Two months (37 CFR 1.17(a)(2))	$600	$300	$150	$
☐	Three months (37 CFR 1.17(a)(3))	$1,400	$700	$350	$
☐	Four months (37 CFR 1.17(a)(4))	$2,200	$1,100	$550	$
☐	Five months (37 CFR 1.17(a)(5))	$3,000	$1,500	$750	$

☐ Applicant asserts small entity status. See 37 CFR 1.27.

☐ Applicant certifies micro entity status. See 37 CFR 1.29.
Form PTO/SB/15A or B or equivalent must either be enclosed or have been submitted previously.

☐ A check in the amount of the fee is enclosed.

☐ Payment by credit card. Form PTO-2038 is attached.

☐ The Director has already been authorized to charge fees in this application to a Deposit Account.

☑ The Director is hereby authorized to charge any fees which may be required, or credit any overpayment, to Deposit Account Number 13-3080.

☑ Payment made via EFS-Web.

WARNING: Information on this form may become public. Credit card information should not be included on this form. Provide credit card information and authorization on PTO-2038.

I am the

☐ applicant.

☑ attorney or agent of record. Registration number 60,308.

☐ attorney or agent acting under 37 CFR 1.34. Registration number _____.

/andrew.j.paprocki/	August 12, 2019
Signature	Date
Andrew J. Paprocki	414-225-4947
Typed or printed name	Telephone Number

NOTE: This form must be signed in accordance with 37 CFR 1.33. See 37 CFR 1.4 for signature requirements and certifications. Submit multiple forms if more than one signature is required, see below*.

☑ * Total of 1 forms are submitted.

This collection of information is required by 37 CFR 1.136(a). The information is required to obtain or retain a benefit by the public, which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 6 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. SEND TO: Mail Stop PCT, Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.

Electronic Patent Application Fee Transmittal

Application Number:	16160230
Filing Date:	15-Oct-2018
Title of Invention:	SCANNING SEQUENCE FOR AN INTRA-ORAL IMAGING SYSTEM
First Named Inventor/Applicant Name:	Robert F. Dillon
Filer:	Andrew J. Paprocki/Elizabeth Tressler
Attorney Docket Number:	208764-9006-US02

Filed as Large Entity

Filing Fees for Utility under 35 USC 111(a)

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
Pages:				
Claims:				
Miscellaneous-Filing:				
Petition:				
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				
Extension-of-Time:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Extension - 1 month with $0 paid	1251	1	200	200
Miscellaneous:				
			Total in USD ($)	**200**

Electronic Acknowledgement Receipt

EFS ID:	36844097
Application Number:	16160230
International Application Number:	
Confirmation Number:	8509
Title of Invention:	SCANNING SEQUENCE FOR AN INTRA-ORAL IMAGING SYSTEM
First Named Inventor/Applicant Name:	Robert F. Dillon
Customer Number:	129916
Filer:	Andrew J. Paprocki/Elizabeth Tressler
Filer Authorized By:	Andrew J. Paprocki
Attorney Docket Number:	208764-9006-US02
Receipt Date:	12-AUG-2019
Filing Date:	15-OCT-2018
Time Stamp:	12:23:56
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	CARD
Payment was successfully received in RAM	$200
RAM confirmation Number	E20198BC26104765
Deposit Account	133080
Authorized User	Elizabeth Tressler

The Director of the USPTO is hereby authorized to charge indicated fees and credit any overpayment as follows:

37 CFR 1.16 (National application filing, search, and examination fees)

37 CFR 1.17 (Patent application and reexamination processing fees)

37 CFR 1.19 (Document supply fees)

37 CFR 1.20 (Post Issuance fees)

37 CFR 1.21 (Miscellaneous fees and charges)

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1		208764-9006-US02_Response_filed_8-12-19.pdf	114527 f49252f4db7a6a3839e5acfb730d5679534525b3	yes	10
	Multipart Description/PDF files in .zip description				
	Document Description		**Start**	**End**	
	Amendment/Req. Reconsideration-After Non-Final Reject		1	1	
	Claims		2	7	
	Applicant Arguments/Remarks Made in an Amendment		8	10	
Warnings:					
Information:					
2	Extension of Time	208764-9006-US02_Extension_filed_8-12-19.pdf	127636 f85bbea8bda9c180380873b6a27cf1fd89356cd3	no	1
Warnings:					
Information:					
3	Fee Worksheet (SB06)	fee-info.pdf	31074 33d68a77f93270b7b4922f651f157e4a6c15a4fd	no	2
Warnings:					
Information:					
		Total Files Size (in bytes):	273237		

This Acknowledgement Receipt evidences receipt on the noted date by the USPTO of the indicated documents, characterized by the applicant, and including page counts, where applicable. It serves as evidence of receipt similar to a Post Card, as described in MPEP 503.

New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

If a new international application is being filed and the international application includes the necessary components for an international filing date (see PCT Article 11 and MPEP 1810), a Notification of the International Application Number and of the International Filing Date (Form PCT/RO/105) will be issued in due course, subject to prescriptions concerning national security, and the date shown on this Acknowledgement Receipt will establish the international filing date of the application.

UNITED STATES DEPARTMENT OF COMMERCE
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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
16/160,230	10/15/2018	Robert F. Dillon	208764-9006-US02	8509

129916 7590 04/17/2019

Michael Best & Friedrich LLP (DITC)
100 East Wisconsin Avenue
Suite 3300
Milwaukee, WI 53202

EXAMINER	
BALI, VIKKRAM	

ART UNIT	PAPER NUMBER
2663	

NOTIFICATION DATE	DELIVERY MODE
04/17/2019	ELECTRONIC

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

mkeipdocket@michaelbest.com

Office Action Summary	Application No. 16/160,230	Applicant(s) Dillon et al.	
	Examiner VIKKRAM BALI	Art Unit 2663	AIA (FITF) Status No

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTHS FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☐ Responsive to communication(s) filed on _____.

☐ A declaration(s)/affidavit(s) under **37 CFR 1.130(b)** was/were filed on _____.

2a)☐ This action is **FINAL.** 2b) ☑ This action is non-final.

3)☐ An election was made by the applicant in response to a restriction requirement set forth during the interview on _____; the restriction requirement and election have been incorporated into this action.

4)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims*

5) ☑ Claim(s) 1-24 is/are pending in the application.

5a) Of the above claim(s) _____ is/are withdrawn from consideration.

6) ☐ Claim(s) _____ is/are allowed.

7) ☑ Claim(s) 1-24 is/are rejected.

8) ☐ Claim(s) _____ is/are objected to.

9) ☐ Claim(s) _____ are subject to restriction and/or election requirement

* If any claims have been determined allowable, you may be eligible to benefit from the **Patent Prosecution Highway** program at a participating intellectual property office for the corresponding application. For more information, please see http://www.uspto.gov/patents/init_events/pph/index.jsp or send an inquiry to **PPHfeedback@uspto.gov.**

Application Papers

10)☐ The specification is objected to by the Examiner.

11)☑ The drawing(s) filed on 10/15/2018 is/are: a)☑ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

Certified copies:

a)☐ All b)☐ Some** c)☐ None of the:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

** See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☑ Notice of References Cited (PTO-892)

2) ☑ Information Disclosure Statement(s) (PTO/SB/08a and/or PTO/SB/08b) Paper No(s)/Mail Date _____.

3) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date _____.

4) ☐ Other: _____.

DETAILED ACTION

Notice of Pre-AIA or AIA Status

1. The present application is being examined under the pre-AIA first to invent provisions.

Claim Rejections - 35 USC § 102

2. The following is a quotation of the appropriate paragraphs of pre-AIA 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

3. Claim(s) 1-4, 6, 12-15 and 17 are rejected under pre-AIA 35 U.S.C. 102(b) as being anticipated by Chapoulaud et al (US 2004/0265770).

With respect to claim 1, Chapoulaud discloses generating an intra-oral scan of a dentition, the system comprising (see Abstract):

a memory; a processor coupled to the memory, wherein the processor is configured to (see figure 1):

generate a contiguous scan of an occlusal surface of at least a part of one arch of the dentition, and associate a scan of at least one additional surface to the contiguous scan of the occlusal surface, (see figure 1, 3, 3A, 3B, and 4, and paragraph 0071) as claimed.

With respect to claim 2, he further discloses wherein the scan of the at least one additional surface comprises a plurality of scans of labial surfaces and a plurality of scans of lingual surfaces, (see figure 4, and paragraph 0071) as claimed.

With respect to claim 3, he further discloses wherein each scan of a labial or lingual surface includes a part of the occlusal surface, and wherein the processor is configured to use the part of the occlusal surface that is included in each scan of the labial or lingual surface to associate the labial or lingual surface to the contiguous scan of the occlusal surface, (see figure 4 and paragraph 0071) as claimed.

With respect to claim 4, he further discloses wherein the occlusal surface is imaged prior to the plurality of labial and lingual surfaces, and wherein the processor is further configured to display in real-time a three-dimensional representation of the dentition as the plurality of labial and lingual surfaces are imaged, (see figure 4) as claimed.

With respect to claim 6, he further discloses wherein the processor is further configured to generate an occlusal backbone by matching selected frames of the contiguous scan of the occlusal surface that have an overlap based on an analysis of data, (see figure 3A, 3B, and 4, and paragraph 0071) as claimed.

Claims 12-15 and 17, are for the same reason as set forth in the rejections for claims 1-4 and 6, because claims 12-15 and 17 are claiming subject matter similar to the claimed subject in claims 1-4 and 6.

Claim Rejections - 35 USC § 103

4. The following is a quotation of pre-AIA 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

5. Claims 5, 7, 8, 11, 16, 18, 19 and 22-24 are rejected under pre-AIA 35 U.S.C. 103(a) as being unpatentable over Chapoulaud et al (US 2004/0265770) in view of Dillon et al (US 2012/0062557).

With respect to claim 5, Chapoulaud discloses all the limitations as claimed in claim 3 and as rejected above. However, he fails to disclose wherein the processor is configured to display in real-time the three-dimensional representation of the dentition by performing a coarse matching by matching features as the plurality of labial and lingual surfaces are imaged, and wherein the processor is further configured to generate a three-dimensional reconstruction of the dentition based on a point cloud alignment after the plurality of labial and lingual surfaces are all imaged, as claimed.

Dillon in the same field teaches wherein the processor is configured to display in real-time the three-dimensional representation of the dentition by performing a coarse matching by matching features as the plurality of labial and lingual surfaces are imaged, and wherein the

processor is further configured to generate a three-dimensional reconstruction of the dentition based on a point cloud alignment after the plurality of labial and lingual surfaces are all imaged, (see paragraph 0046), as claimed.

Therefore, it would have been obvious to one ordinary skilled in the art at the time of invention to combine the two references as they are analogous because they are solving similar problem of intra oral scanning. The teachings of Dillon of data display in real time using the 3D point cloud can be incorporated into Chapoulaud's system for the ease of the system.

With respect to claim 7, Dillon further teaches wherein the processor is configured to detect the overlap based on noise characteristics of the data, (see paragraph 0037, right hand column last 6 lines, checking if the two displays are similar "noise characteristics") as claimed.

With respect to claim 8, Chapoulaud further discloses wherein the occlusal backbone is a first occlusal backbone, and wherein the processor is further configured to generate a second occlusal backbone that is more accurate than the first occlusal backbone by linking other frames that are different from the selected frames to the first occlusal backbone, (see paragraph 0071, low and high resolution imaging is read as first and second occlusal backbone imaging) as claimed.

With respect to claim 11, Chapoulaud discloses all the limitations as claimed in claim 1 and as rejected above. However, he fails to disclose a projector that projects interferometric fringes on an occlusal surface of at least a part of one arch of the dentition primarily along an

anterior-posterior direction; and an imaging sensor that is used to view the interferometric fringes, wherein the processor is further configured to generate the contiguous scan of the occlusal surface based on the interferometric fringes sensed by the imaging sensor, as claimed.

Dillon in the same field teaches a projector that projects interferometric fringes on an occlusal surface of at least a part of one arch of the dentition primarily along an anterior-posterior direction; and an imaging sensor that is used to view the interferometric fringes, wherein the processor is further configured to generate the contiguous scan of the occlusal surface based on the interferometric fringes sensed by the imaging sensor, as claimed, (see figure 2, numerical 22, and paragraph 0028), as claimed.

Therefore, it would have been obvious to one ordinary skilled in the art at the time of invention to combine the two references as they are analogous because they are solving similar problem of intra oral scanning. The teachings of Dillon of having a wand to scan can be incorporated into Chapoulaud's system for the ease of the system.

Claim 22 is rejected for the same reasons as set forth in the rejections for claims 1+11, because claim 22 is claiming subject matter as claimed in the scope of claims 1+11.

With respect to claims 23 and 24, combination of Chapoulaud and Dillon discloses generate a contiguous scan of an occlusal surface, and associate at least one additional surface to the contiguous scan of the occlusal surface; and wherein the at least one additional surface comprises a plurality of labial surfaces and a plurality of lingual surfaces, (see figure 4 of Chapoulaud and figures 3, 4 and paragraph 0028 of Dillon) as claimed.

Claims 16, 18 and 19, are for the same reason as set forth in the rejections for claims 5, 7 and 8, because claims 16, 18 and 19 are claiming subject matter similar to the claimed subject in claims 5, 7 and 8.

6. Claims 9, 10, 20 and 21 are rejected under pre-AIA 35 U.S.C. 103(a) as being unpatentable over Chapoulaud et al (US 2004/0265770) in view of Dillon et al (US 2012/0062557) as applied to claim 8 above, and further in view of Deichmann et al (US Pub. 2013/0218530).

With respect to claims 9 and 10, Chapoulaud and Dillon discloses all the limitations as claimed in claim 8 and as rejected above. However, they fails to disclose wherein the processor is further configured to generate a third occlusal backbone by removing, from the second occlusal backbone, areas representing at least one selected from a group consisting of a tongue, a cheek, and a lip; and wherein the processor is configured to remove the areas representing the at least one selected from the group consisting of the tongue, the cheek, and the lip based on differences in surface normal, color, or rigidity properties, as claimed.

Deichmann in the same field teaches wherein the processor is further configured to generate a third occlusal backbone by removing, from the second occlusal backbone, areas representing at least one selected from a group consisting of a tongue, a cheek, and a lip; and wherein the processor is configured to remove the areas representing the at least one selected from the group consisting of the tongue, the cheek, and the lip based on differences in surface normal,

color, or rigidity properties, (see paragraph 0101, wherein the a segmenting is performed to cutoff the lip and teeth image in order to get the image using a color difference) as claimed.

Therefore, it would have been obvious to one ordinary skilled in the art at the time of invention to combine the references as they are analogous because they are solving similar problem of intra oral scanning. The teachings of Deichmann of segmenting the images to get the clear image of teeth can be incorporated into Chapoulaud's and Dillon system to yield the clear imagery.

Claims 20 and 21, are for the same reason as set forth in the rejections for claims 9 and 10, because claims 20 and 21 are claiming subject matter similar to the claimed subject in claims 9 and 10.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to VIKKRAM BALI whose telephone number is (571)272-7415. The examiner can normally be reached on Monday-Friday 7:00AM-3:00PM.

Examiner interviews are available via telephone, in-person, and video conferencing using a USPTO supplied web-based collaboration tool. To schedule an interview, applicant is encouraged to use the USPTO Automated Interview Request (AIR) at http://www.uspto.gov/interviewpractice.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Dwayne Bost can be reached on 571-272-7023. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/VIKKRAM BALI/
Primary Examiner, Art Unit 2663

Notice of References Cited	Application/Control No. 16/160,230	Applicant(s)/Patent Under Reexamination Dillon et al.	
	Examiner VIKKRAM BALI	Art Unit 2663	Page 1 of 1

U.S. PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Name	CPC Classification	US Classification
*	A	US-20130218530-A1	08-2013	Deichmann; Nikolaj	A61C13/0004	703/1
	B					
	C					
	D					
	E					
	F					
	G					
	H					
	I					
	J					
	K					
	L					
	M					

FOREIGN PATENT DOCUMENTS

*		Document Number Country Code-Number-Kind Code	Date MM-YYYY	Country	Name	CPC Classification
	N					
	O					
	P					
	Q					
	R					
	S					
	T					

NON-PATENT DOCUMENTS

*		Include as applicable: Author, Title Date, Publisher, Edition or Volume, Pertinent Pages)
	U	
	V	
	W	
	X	

*A copy of this reference is not being furnished with this Office action. (See MPEP § 707.05(a).)
Dates in MM-YYYY format are publication dates. Classifications may be US or foreign.

Index of Claims	Application/Control No.	Applicant(s)/Patent Under Reexamination
	16/160,230	Dillon et al.
	Examiner	Art Unit
	VIKKRAM BALI	2663

✓	Rejected	-	Cancelled	N	Non-Elected	A	Appeal
=	Allowed	÷	Restricted	I	Interference	O	Objected

CLAIMS

☐ Claims renumbered in the same order as presented by applicant ☐ CPA ☐ T.D. ☐ R.1.47

CLAIM		DATE								
Final	Original	04/12/2019								
	1	✓								
	2	✓								
	3	✓								
	4	✓								
	5	✓								
	6	✓								
	7	✓								
	8	✓								
	9	✓								
	10	✓								
	11	✓								
	12	✓								
	13	✓								
	14	✓								
	15	✓								
	16	✓								
	17	✓								
	18	✓								
	19	✓								
	20	✓								
	21	✓								
	22	✓								
	23	✓								
	24	✓								

Search Notes	Application/Control No.	Applicant(s)/Patent Under Reexamination
	16/160,230	Dillon et al.
	Examiner	Art Unit
	VIKKRAM BALI	2663

CPC - Searched*		
Symbol	Date	Examiner

CPC Combination Sets - Searched*		
Symbol	Date	Examiner

US Classification - Searched*			
Class	Subclass	Date	Examiner

* See search history printout included with this form or the SEARCH NOTES box below to determine the scope of the search.

Search Notes		
Search Notes	Date	Examiner
Inventor name search	04/12/2019	vb
Limited text search in EAST and CPC - A61B$.CPC. A61C9$.CPC.	04/12/2019	vb
NPL search	04/12/2019	vb

Interference Search			
US Class/CPC Symbol	US Subclass/CPC Group	Date	Examiner

EAST Search History

EAST Search History (Prior Art)

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
L1	4	"6648640".pn. "7286954".pn.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2019/04/12 13:27
L2	5	"20120062557".pn. "20040265770".pn.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2019/04/12 13:30
L3	0	2 and (cheek lip tongue)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2019/04/12 13:30
L4	2	2 and (color rigid$)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2019/04/12 13:31
L5	50	"s362" and (cheek lip tongue)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2019/04/12 14:16
L6	739	(oral and imag$4 and cavity and (wand handpiece scan$4) and occlusal and project$4 and (teeth tooth))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2019/04/12 14:16
L7	278	L6 and (cheek lip tongue)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2019/04/12 14:16
L8	50	L6 and ((segment$4 differenc$4 substract$4) same (cheek lip tongue))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2019/04/12 14:17
L9	35	L6 and ((segment$4 differenc$4 substract$4) same (tongue))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2019/04/12 14:27
L10	489	((segment$4 differenc$4 substract$4) same (tongue) same image)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2019/04/12 15:56

L11	7	6 and 10	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2019/04/12 15:56
L12	1904	((segment$4 differenc$4 substract$4) same (cheek lip tongue) same image)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2019/04/12 15:58
L13	13	6 and 12	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2019/04/12 15:59
L14	323	12 and (occlusal teeth tooth dentit$3 jaw)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2019/04/12 16:14
L15	135	12 same (occlusal teeth tooth dentit$3 jaw)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2019/04/12 16:14
S1	10	"9622834".pn. "9157733".pn. "20120062557".pn.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2017/06/12 11:07
S2	2	S1 and (oral and imag$4 and cavity and (wand handpiece) and occlusal)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2017/06/12 11:08
S3	150	(oral and imag$4 and cavity and (wand handpiece) and occlusal)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2017/06/12 11:13
S4	39	S3 and (lingual and labial)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2017/06/12 11:14
S5	719	ormco.asn.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2017/06/12 11:22
S6	2	S5 and (oral and imag$4 and cavity and (wand handpiece) and occlusal)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2017/06/12 11:22
S7	11	S5 and (oral and imag$4 and cavity and project$3)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2017/06/12 11:24

S8	5	S5 and (oral and imag$4 and cavity and project$3 and occlusal)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2017/06/12 11:28
S9	267	(dillon near robert).in.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2017/06/12 15:12
S10	218	(andreiko near craig).in.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2017/06/12 15:12
S11	12	(vesper near andrew).in.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2017/06/12 15:14
S12	178	(judell near neil).in.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2017/06/12 15:14
S13	41	(fillion near timothy).in.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2017/06/12 15:14
S14	598	S9 S10 S11 S12 S13	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2017/06/12 15:15
S15	13	S14 and (oral and imag$4 and cavity and project$3)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2017/06/12 15:18
S16	172337	A61B$.CPC. A61C9$.CPC.	USPAT	OR	OFF	2017/06/12 16:05
S17	580	(oral and imag$4 and cavity and (wand handpiece scan$4) and occlusal and project$4 and (teeth tooth))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2017/06/12 16:06
S18	153	S16 and S17	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2017/06/12 16:07
S19	1	(oral and imag$4 and cavity and (wand handpiece scan$4) and occlusal and project$4 and (teeth tooth)).clm.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2017/06/12 16:07
S20	1	"8390822".pn.	USPAT	OR	OFF	2017/06/13 09:07

S21	0	S20 and (occlusal)	USPAT	OR	OFF	2017/06/13 09:10
S22	10	"9622834".pn. "9157733".pn. "20120062557".pn.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2017/06/13 09:15
S23	17	(backbone bone (back adj2 bone)) near occlusal	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2018/04/23 12:02
S24	2	("2014/0272774").URPN.	USPAT	OR	ON	2018/04/23 12:04
S25	1	(oral and imag$4 and cavity and (wand handpiece scan$4) and occlusal and project$4 and (teeth tooth)).clm.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2018/06/14 13:56
S26	17	s22s	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2018/06/14 13:56
S27	10	"9622834".pn. "9157733".pn. "20120062557".pn.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2018/06/14 13:56
S28	10	S27	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2018/06/14 13:56
S29	18	(backbone bone (back adj2 bone)) near occlusal	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	ON	2018/06/14 13:56
S30	18	S29	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2018/06/14 13:56
S31	186805	A61B$.CPC. A61C9$.CPC.	USPAT	OR	OFF	2018/06/14 13:57
S32	675	(oral and imag$4 and cavity and (wand handpiece scan$4) and occlusal and project$4 and (teeth tooth))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2018/06/14 13:57
S33	187	S31 and S32	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2018/06/14 13:57
S34	187	S33	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO;	OR	OFF	2018/06/14 13:57

			DERWENT; IBM_TDB			
S35	199441	A61B$.CPC. A61C9$.CPC.	USPAT	OR	OFF	2019/04/12 08:25
S36	739	(oral and imag$4 and cavity and (wand handpiece scan$4) and occlusal and project$4 and (teeth tooth))	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2019/04/12 08:25
S37	211	S35 and S36	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2019/04/12 08:25
S38	307	(dillon near robert).in.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2019/04/12 08:26
S39	236	(andreiko near craig).in.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2019/04/12 08:26
S40	17	(vesper near andrew).in.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2019/04/12 08:26
S41	193	(judell near neil).in.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2019/04/12 08:26
S42	50	(fillion near timothy).in.	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2019/04/12 08:26
S43	657	S38 S39 S40 S41 S42	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2019/04/12 08:26
S44	17	S43 and (oral and imag$4 and cavity and project$3)	US-PGPUB; USPAT; USOCR; FPRS; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2019/04/12 08:26
S45	8	("20040265770" | "20050058962" | "20120062557" | "20120129119" | "6402707" | "7717708" | "7905725" | "8390822").PN.	US-PGPUB; USPAT	OR	ON	2019/04/12 09:56

4/12/2019 5:11:48 PM
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Doc code: IDS
Doc description: Information Disclosure Statement (IDS) Filed

PTO/SB/08a (03-15)
Approved for use through 07/31/2016. OMB 0651-0031
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INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(Not for submission under 37 CFR 1.99)

Application Number	
Filing Date	
First Named Inventor	Robert F. Dillon
Art Unit	
Examiner Name	
Attorney Docket Number	208764-9006-US02

U.S.PATENTS Remove

Examiner Initial*	Cite No	Patent Number	Kind Code[1]	Issue Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1	6402707		2002-06-11	Ernst	
	2	7717708		2010-05-18	Sachdeva et al.	
	3	7905725		2011-03-15	Chishti et al.	
	4	8390822		2013-03-05	Dillon et al.	

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	1	20040265770		2004-12-30	Chapoulaud et al.	
	2	20050058962		2005-03-17	Siemons et al.	

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	
	Filing Date	
	First Named Inventor	Robert F. Dillon
	Art Unit	
	Examiner Name	
	Attorney Docket Number	208764-9006-US02

	3	20120062557		2012-03-15	Dillon et al.		
	4	20120129119		2012-05-24	Oda		

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Examiner Initials*	Cite No	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc), date, pages(s), volume-issue number(s), publisher, city and/or country where published.	T[5]
	1		

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EXAMINER SIGNATURE

Examiner Signature	/VIKKRAM BALI/	Date Considered	04/12/2019

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[1] See Kind Codes of USPTO Patent Documents at www.USPTO.GOV or MPEP 901.04. [2] Enter office that issued the document, by the two-letter code (WIPO Standard ST.3). [3] For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. [4] Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST.16 if possible. [5] Applicant is to place a check mark here if English language translation is attached.

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT

(Not for submission under 37 CFR 1.99)

Application Number	
Filing Date	
First Named Inventor	Robert F. Dillon
Art Unit	
Examiner Name	
Attorney Docket Number	208764-9006-US02

CERTIFICATION STATEMENT

Please see 37 CFR 1.97 and 1.98 to make the appropriate selection(s):

That each item of information contained in the information disclosure statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(1).

OR

☐ That no item of information contained in the information disclosure statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the person signing the certification after making reasonable inquiry, no item of information contained in the information disclosure statement was known to any individual designated in 37 CFR 1.56(c) more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(2).

See attached certification statement.

The fee set forth in 37 CFR 1.17 (p) has been submitted herewith.

☒ A certification statement is not submitted herewith.

SIGNATURE

A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.

Signature	/andrew j. paprocki/	Date (YYYY-MM-DD)	2018-10-15
Name/Print	Andrew J. Paprocki	Registration Number	60308

This collection of information is required by 37 CFR 1.97 and 1.98. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 1 hour to complete, including gathering, preparing and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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Bibliographic Data

Application No: 16/160,230

Foreign Priority claimed: ○ Yes ◉ No

35 USC 119 (a-d) conditions met: ☐ Yes ☑ No ☐ Met After Allowance

Verified and Acknowledged: /VIKKRAM BALI/ Examiner's Signature | Initials

Title: SCANNING SEQUENCE FOR AN INTRA-ORAL IMAGING SYSTEM

FILING or 371(c) DATE	CLASS	GROUP ART UNIT	ATTORNEY DOCKET NO.
10/15/2018	382	2663	208764-9006-US02
RULE			

APPLICANTS

ORMCO CORPORATION, Orange, CA,

INVENTORS

Robert F. Dillon Bedford, NH, UNITED STATES

Craig A. Andreiko

Andrew F. Vesper Townsend, MA, UNITED STATES

Neil H.K. Judell Cambridge, MA, UNITED STATES

Timothy I. Fillion Bedford, MA, UNITED STATES

CONTINUING DATA

This application is a CON of 14209648 03/13/2014 PAT 10098713

14209648 has PRO of 61784535 03/14/2013

FOREIGN APPLICATIONS

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11/02/2018

STATE OR COUNTRY

UNITED STATES

ADDRESS

Michael Best & Friedrich LLP (DITC)

100 East Wisconsin Avenue

Suite 3300

Milwaukee, WI 53202

UNITED STATES

FILING FEE RECEIVED

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APPLICATION NUMBER	FILING OR 371(C) DATE	FIRST NAMED APPLICANT	ATTY. DOCKET NO./TITLE
16/160,230	10/15/2018	Robert F. Dillon	208764-9006-US02

CONFIRMATION NO. 8509

129916
Michael Best & Friedrich LLP (DITC)
100 East Wisconsin Avenue
Suite 3300
Milwaukee, WI 53202

PUBLICATION NOTICE

OC00000010590828 1

Title:SCANNING SEQUENCE FOR AN INTRA-ORAL IMAGING SYSTEM

Publication No.US-2019-0046304-A1
Publication Date:02/14/2019

NOTICE OF PUBLICATION OF APPLICATION

The above-identified application will be electronically published as a patent application publication pursuant to 37 CFR 1.211, et seq. The patent application publication number and publication date are set forth above.

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The publication process established by the Office does not provide for mailing a copy of the publication to applicant. A copy of the publication may be obtained from the Office upon payment of the appropriate fee set forth in 37 CFR 1.19(a)(1). Orders for copies of patent application publications are handled by the USPTO's Public Records Division. The Public Records Division can be reached by telephone at (571) 272-3150 or (800) 972-6382, by facsimile at (571) 273-3250, by mail addressed to the United States Patent and Trademark Office, Public Records Division, Alexandria, VA 22313-1450 or via the Internet.

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APPLICATION NUMBER	FILING or 371(c) DATE	GRP ART UNIT	FIL FEE REC'D	ATTY.DOCKET.NO	TOT CLAIMS	IND CLAIMS
16/160,230	10/15/2018	3732	2120	208764-9006-US02	24	3

CONFIRMATION NO. 8509

FILING RECEIPT

129916
Michael Best & Friedrich LLP (DITC)
100 East Wisconsin Avenue
Suite 3300
Milwaukee, WI 53202

OC000000103363294

Date Mailed: 11/06/2018

Receipt is acknowledged of this non-provisional patent application. The application will be taken up for examination in due course. Applicant will be notified as to the results of the examination. Any correspondence concerning the application must include the following identification information: the U.S. APPLICATION NUMBER, FILING DATE, NAME OF APPLICANT, and TITLE OF INVENTION. Fees transmitted by check or draft are subject to collection. Please verify the accuracy of the data presented on this receipt. **If an error is noted on this Filing Receipt, please submit a written request for a Filing Receipt Correction. Please provide a copy of this Filing Receipt with the changes noted thereon. If you received a "Notice to File Missing Parts" for this application, please submit any corrections to this Filing Receipt with your reply to the Notice. When the USPTO processes the reply to the Notice, the USPTO will generate another Filing Receipt incorporating the requested corrections**

Inventor(s)

Robert F. Dillon, Bedford, NH;
Craig A. Andreiko, Residence Not Provided, Deceased;
Andrew F. Vesper, Townsend, MA;
Neil H.K. Judell, Cambridge, MA;
Timothy I. Fillion, Bedford, MA;

Applicant(s)

ORMCO CORPORATION, Orange, CA;

Power of Attorney: The patent practitioners associated with Customer Number 129916

Domestic Priority data as claimed by applicant

This application is a CON of 14/209,648 03/13/2014 PAT 10098713
which claims benefit of 61/784,535 03/14/2013

Foreign Applications for which priority is claimed (You may be eligible to benefit from the **Patent Prosecution Highway** program at the USPTO. Please see http://www.uspto.gov for more information.) - None.
Foreign application information must be provided in an Application Data Sheet in order to constitute a claim to foreign priority. See 37 CFR 1.55 and 1.76.

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Permission to Access Search Results: Yes

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If Required, Foreign Filing License Granted: 11/02/2018

The country code and number of your priority application, to be used for filing abroad under the Paris Convention, is **US 16/160,230**

Projected Publication Date: 02/14/2019

Non-Publication Request: No

Early Publication Request: No

Title

SCANNING SEQUENCE FOR AN INTRA-ORAL IMAGING SYSTEM

Preliminary Class

433

Statement under 37 CFR 1.55 or 1.78 for AIA (First Inventor to File) Transition Applications: No

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PATENT APPLICATION FEE DETERMINATION RECORD

Substitute for Form PTO-875

Application or Docket Number: 16/160,230

APPLICATION AS FILED - PART I

FOR	(Column 1) NUMBER FILED	(Column 2) NUMBER EXTRA	SMALL ENTITY RATE($)	SMALL ENTITY FEE($)	OR	OTHER THAN SMALL ENTITY RATE($)	OTHER THAN SMALL ENTITY FEE($)
BASIC FEE (37 CFR 1.16(a), (b), or (c))	N/A	N/A	N/A			N/A	300
SEARCH FEE (37 CFR 1.16(k), (i), or (m))	N/A	N/A	N/A			N/A	660
EXAMINATION FEE (37 CFR 1.16(o), (p), or (q))	N/A	N/A	N/A			N/A	760
TOTAL CLAIMS (37 CFR 1.16(i))	24 minus 20 =	* 4			OR	x 100 =	400
INDEPENDENT CLAIMS (37 CFR 1.16(h))	3 minus 3 =	*				x 460 =	0.00
APPLICATION SIZE FEE (37 CFR 1.16(s))	If the specification and drawings exceed 100 sheets of paper, the application size fee due is $310 ($155 for small entity) for each additional 50 sheets or fraction thereof. See 35 U.S.C. 41(a)(1)(G) and 37 CFR 1.16(s).						0.00
MULTIPLE DEPENDENT CLAIM PRESENT (37 CFR 1.16(j))							0.00
* If the difference in column 1 is less than zero, enter "0" in column 2.			TOTAL			TOTAL	2120

APPLICATION AS AMENDED - PART II

		(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	SMALL ENTITY RATE($)	SMALL ENTITY ADDITIONAL FEE($)	OR	OTHER THAN SMALL ENTITY RATE($)	OTHER THAN SMALL ENTITY ADDITIONAL FEE($)
AMENDMENT A	Total (37 CFR 1.16(i))	*	Minus	**	=	x =		OR	x =	
	Independent (37 CFR 1.16(h))	*	Minus	***	=	x =		OR	x =	
	Application Size Fee (37 CFR 1.16(s))									
	FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							OR		
						TOTAL ADD'L FEE		OR	TOTAL ADD'L FEE	

		(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA	SMALL ENTITY RATE($)	SMALL ENTITY ADDITIONAL FEE($)	OR	OTHER THAN SMALL ENTITY RATE($)	OTHER THAN SMALL ENTITY ADDITIONAL FEE($)
AMENDMENT B	Total (37 CFR 1.16(i))	*	Minus	**	=	x =		OR	x =	
	Independent (37 CFR 1.16(h))	*	Minus	***	=	x =		OR	x =	
	Application Size Fee (37 CFR 1.16(s))									
	FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM (37 CFR 1.16(j))							OR		
						TOTAL ADD'L FEE		OR	TOTAL ADD'L FEE	

* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.

** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20".

*** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3".

The "Highest Number Previously Paid For" (Total or Independent) is the highest found in the appropriate box in column 1.

PTO/AIA/82A (07-13)
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NOTE: This form is to be submitted with the Power of Attorney by Applicant form (PTO/AIA/82B) to identify the application to which the Power of Attorney is directed, in accordance with 37 CFR 1.5, unless the application number and filing date are identified in the Power of Attorney by Applicant form. If neither form PTO/AIA/82A nor form PTO/AIA82B identifies the application to which the Power of Attorney is directed, the Power of Attorney will not be recognized in the application.

Application Number	
Filing Date	
First Named Inventor	Robert F. Dillon
Title	SCANNING SEQUENCE FOR AN INTRA-ORAL IMAGING SYSTEM
Art Unit	
Examiner Name	
Attorney Docket Number	208764-9006-US02

SIGNATURE of Applicant or Patent Practitioner

Signature	/andrew j. paprocki/	Date (Optional)	October 15, 2018
Name	Andrew J. Paprocki	Registration Number	60,308
Title (if Applicant is a juristic entity)			
Applicant Name (if Applicant is a juristic entity)			

NOTE: This form must be signed in accordance with 37 CFR 1.33. See 37 CFR 1.4(d) for signature requirements and certifications. If more than one applicant, use multiple forms.

☑ *Total of 1 forms are submitted.

This collection of information is required by 37 CFR 1.131, 1.32, and 1.33. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 3 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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Doc Code: PA..
Document Description: Power of Attorney

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POWER OF ATTORNEY BY APPLICANT

I hereby revoke all previous powers of attorney given in the application identified in either the attached transmittal letter or the boxes below.

Application Number	Filing Date

(Note: The boxes above may be left blank if information is provided on form PTO/AIA/82A.)

☑ I hereby appoint the Patent Practitioner(s) associated with the following Customer Number as my/our attorney(s) or agent(s), and to transact all business in the United States Patent and Trademark Office connected therewith for the application referenced in the attached transmittal letter (form PTO/AIA/82A) or identified above: 129916

OR

☐ I hereby appoint Practitioner(s) named in the attached list (form PTO/AIA/82C) as my/our attorney(s) or agent(s), and to transact all business in the United States Patent and Trademark Office connected therewith for the patent application referenced in the attached transmittal letter (form PTO/AIA/82A) or identified above. (Note: Complete form PTO/AIA/82C.)

Please recognize or change the correspondence address for the application identified in the attached transmittal letter or the boxes above to:

☑ The address associated with the above-mentioned Customer Number

OR

☐ The address associated with Customer Number:

OR

Firm or Individual Name					
Address					
City		State		Zip	
Country					
Telephone		Email			

I am the Applicant (if the Applicant is a juristic entity, list the Applicant name in the box):

Ormco Corporation

☐ Inventor or Joint Inventor (title not required below)

☐ Legal Representative of a Deceased or Legally Incapacitated Inventor (title not required below)

☑ Assignee or Person to Whom the Inventor is Under an Obligation to Assign (provide signer's title if applicant is a juristic entity)

☐ Person Who Otherwise Shows Sufficient Proprietary Interest (e.g., a petition under 37 CFR 1.46(b)(2) was granted in the application or is concurrently being filed with this document) (provide signer's title if applicant is a juristic entity)

SIGNATURE of Applicant for Patent

The undersigned (whose title is supplied below) is authorized to act on behalf of the applicant (e.g., where the applicant is a juristic entity).

Signature		Date (Optional)	5-6-15
Name	Jason Davis		
Title	VP - Finance		

NOTE: Signature - This form must be signed by the applicant in accordance with 37 CFR 1.33. See 37 CFR 1.4 for signature requirements and certifications. If more than one applicant, use multiple forms.

☑ Total of 1 forms are submitted.

This collection of information is required by 37 CFR 1.131, 1.32, and 1.33. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.11 and 1.14. This collection is estimated to take 3 minutes to complete, including gathering, preparing, and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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INFORMATION DISCLOSURE STATEMENT BY APPLICANT
(Not for submission under 37 CFR 1.99)

Application Number	
Filing Date	
First Named Inventor	Robert F. Dillon
Art Unit	
Examiner Name	
Attorney Docket Number	208764-9006-US02

U.S.PATENTS Remove

Examiner Initial*	Cite No	Patent Number	Kind Code[1]	Issue Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1	6402707		2002-06-11	Ernst	
	2	7717708		2010-05-18	Sachdeva et al.	
	3	7905725		2011-03-15	Chishti et al.	
	4	8390822		2013-03-05	Dillon et al.	

If you wish to add additional U.S. Patent citation information please click the Add button. Add

U.S.PATENT APPLICATION PUBLICATIONS Remove

Examiner Initial*	Cite No	Publication Number	Kind Code[1]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear
	1	20040265770		2004-12-30	Chapoulaud et al.	
	2	20050058962		2005-03-17	Siemons et al.	

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	
	Filing Date	
	First Named Inventor	Robert F. Dillon
	Art Unit	
	Examiner Name	
	Attorney Docket Number	208764-9006-US02

	3	20120062557		2012-03-15	Dillon et al.			
	4	20120129119		2012-05-24	Oda			

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FOREIGN PATENT DOCUMENTS Remove

Examiner Initial*	Cite No	Foreign Document Number[3]	Country Code[2] i	Kind Code[4]	Publication Date	Name of Patentee or Applicant of cited Document	Pages,Columns,Lines where Relevant Passages or Relevant Figures Appear	T[5]
	1							

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Examiner Initials*	Cite No	Include name of the author (in CAPITAL LETTERS), title of the article (when appropriate), title of the item (book, magazine, journal, serial, symposium, catalog, etc), date, pages(s), volume-issue number(s), publisher, city and/or country where published.	T[5]
	1		

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EXAMINER SIGNATURE

Examiner Signature		Date Considered	

*EXAMINER: Initial if reference considered, whether or not citation is in conformance with MPEP 609. Draw line through a citation if not in conformance and not considered. Include copy of this form with next communication to applicant.

[1] See Kind Codes of USPTO Patent Documents at www.USPTO.GOV or MPEP 901.04. [2] Enter office that issued the document, by the two-letter code (WIPO Standard ST.3). [3] For Japanese patent documents, the indication of the year of the reign of the Emperor must precede the serial number of the patent document. [4] Kind of document by the appropriate symbols as indicated on the document under WIPO Standard ST.16 if possible. [5] Applicant is to place a check mark here if English language translation is attached.

INFORMATION DISCLOSURE STATEMENT BY APPLICANT (Not for submission under 37 CFR 1.99)		
	Application Number	
	Filing Date	
	First Named Inventor	Robert F. Dillon
	Art Unit	
	Examiner Name	
	Attorney Docket Number	208764-9006-US02

CERTIFICATION STATEMENT

Please see 37 CFR 1.97 and 1.98 to make the appropriate selection(s):

That each item of information contained in the information disclosure statement was first cited in any communication from a foreign patent office in a counterpart foreign application not more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(1).

OR

☐ That no item of information contained in the information disclosure statement was cited in a communication from a foreign patent office in a counterpart foreign application, and, to the knowledge of the person signing the certification after making reasonable inquiry, no item of information contained in the information disclosure statement was known to any individual designated in 37 CFR 1.56(c) more than three months prior to the filing of the information disclosure statement. See 37 CFR 1.97(e)(2).

See attached certification statement.

The fee set forth in 37 CFR 1.17 (p) has been submitted herewith.

☒ A certification statement is not submitted herewith.

SIGNATURE

A signature of the applicant or representative is required in accordance with CFR 1.33, 10.18. Please see CFR 1.4(d) for the form of the signature.

Signature	/andrew j. paprocki/	Date (YYYY-MM-DD)	2018-10-15
Name/Print	Andrew J. Paprocki	Registration Number	60308

This collection of information is required by 37 CFR 1.97 and 1.98. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 1 hour to complete, including gathering, preparing and submitting the completed application form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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The Privacy Act of 1974 (P.L. 93-579) requires that you be given certain information in connection with your submission of the attached form related to a patent application or patent. Accordingly, pursuant to the requirements of the Act, please be advised that: (1) the general authority for the collection of this information is 35 U.S.C. 2(b)(2); (2) furnishing of the information solicited is voluntary; and (3) the principal purpose for which the information is used by the U.S. Patent and Trademark Office is to process and/or examine your submission related to a patent application or patent. If you do not furnish the requested information, the U.S. Patent and Trademark Office may not be able to process and/or examine your submission, which may result in termination of proceedings or abandonment of the application or expiration of the patent.

The information provided by you in this form will be subject to the following routine uses:

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2. A record from this system of records may be disclosed, as a routine use, in the course of presenting evidence to a court, magistrate, or administrative tribunal, including disclosures to opposing counsel in the course of settlement negotiations.

3. A record in this system of records may be disclosed, as a routine use, to a Member of Congress submitting a request involving an individual, to whom the record pertains, when the individual has requested assistance from the Member with respect to the subject matter of the record.

4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).

5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent Cooperation Treaty.

6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).

7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.

8. A record from this system of records may be disclosed, as a routine use, to the public after either publication of the application pursuant to 35 U.S.C. 122(b) or issuance of a patent pursuant to 35 U.S.C. 151. Further, a record may be disclosed, subject to the limitations of 37 CFR 1.14, as a routine use, to the public if the record was filed in an application which became abandoned or in which the proceedings were terminated and which application is referenced by either a published application, an application open to public inspections or an issued patent.

9. A record from this system of records may be disclosed, as a routine use, to a Federal, State, or local law enforcement agency, if the USPTO becomes aware of a violation or potential violation of law or regulation.

Electronic Patent Application Fee Transmittal

Application Number:	
Filing Date:	
Title of Invention:	SCANNING SEQUENCE FOR AN INTRA-ORAL IMAGING SYSTEM
First Named Inventor/Applicant Name:	Robert F. Dillon
Filer:	Andrew J. Paprocki/Elizabeth Tressler
Attorney Docket Number:	208764-9006-US02

Filed as Large Entity

Filing Fees for Utility under 35 USC 111(a)

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Basic Filing:				
UTILITY APPLICATION FILING	1011	1	300	300
UTILITY SEARCH FEE	1111	1	660	660
UTILITY EXAMINATION FEE	1311	1	760	760
Pages:				
Claims:				
CLAIMS IN EXCESS OF 20	1202	4	100	400
Miscellaneous-Filing:				
Petition:				

Description	Fee Code	Quantity	Amount	Sub-Total in USD($)
Patent-Appeals-and-Interference:				
Post-Allowance-and-Post-Issuance:				
Extension-of-Time:				
Miscellaneous:				
		Total in USD ($)		**2120**

Electronic Acknowledgement Receipt

EFS ID:	34009200
Application Number:	16160230
International Application Number:	
Confirmation Number:	8509
Title of Invention:	SCANNING SEQUENCE FOR AN INTRA-ORAL IMAGING SYSTEM
First Named Inventor/Applicant Name:	Robert F. Dillon
Customer Number:	129916
Filer:	Andrew J. Paprocki/Elizabeth Tressler
Filer Authorized By:	Andrew J. Paprocki
Attorney Docket Number:	208764-9006-US02
Receipt Date:	15-OCT-2018
Filing Date:	
Time Stamp:	15:15:35
Application Type:	Utility under 35 USC 111(a)

Payment information:

Submitted with Payment	yes
Payment Type	CARD
Payment was successfully received in RAM	$2120
RAM confirmation Number	101618INTEFSW15165800
Deposit Account	133080
Authorized User	Elizabeth Tressler

The Director of the USPTO is hereby authorized to charge indicated fees and credit any overpayment as follows:

37 CFR 1.16 (National application filing, search, and examination fees)

37 CFR 1.17 (Patent application and reexamination processing fees)

37 CFR 1.19 (Document supply fees)

37 CFR 1.20 (Post Issuance fees)

37 CFR 1.21 (Miscellaneous fees and charges)

File Listing:

Document Number	Document Description	File Name	File Size(Bytes)/ Message Digest	Multi Part /.zip	Pages (if appl.)
1	Application Data Sheet	208764-9006-US02_ADS_filed_10-15-18.pdf	1823404 c74e476fa267037ecc0cc1c18b88854923eaa467	no	9
Warnings:					
Information:					
2		208764-9006-US02_CON_Application_filed_10-15-18.pdf	138029 7a55fa417a93020de775b9f8411fd7d1fa5797e1	yes	29

Multipart Description/PDF files in .zip description

Document Description	Start	End
Specification	1	22
Claims	23	28
Abstract	29	29

Warnings:					
Information:					
3	Drawings-only black and white line drawings	208764-9006-US02_Drawings_filed_10-15-18.pdf	1078763 f1d76bb500fd6d428c50a828453105d5722091e9	no	20
Warnings:					
Information:					
4	Oath or Declaration filed	208764-9006-US02_Declarations_filed_10-15-18.pdf	358500 fcabda57392a8589311104715 17f536ddf081ecc	no	5
Warnings:					
Information:					
5	Power of Attorney	208764-9006-US02_POA_filed_10-15-18.pdf	276971 ade3d6472440e79e939eadba9120f7aea0d327c2	no	2

Warnings:					
Information:					
6	Information Disclosure Statement (IDS) Form (SB08)	208764-9006-US02_IDS_filed_10-15-18.pdf	1035205 6a50241bddf07ff2dacbbb9eee9fd7a02b65e13d	no	4
Warnings:					
Information:					
7	Fee Worksheet (SB06)	fee-info.pdf	36960 84f22fa0c6fe46e5567f977b09ab146c75882434	no	2
Warnings:					
Information:					
			Total Files Size (in bytes):	4747832	

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New Applications Under 35 U.S.C. 111

If a new application is being filed and the application includes the necessary components for a filing date (see 37 CFR 1.53(b)-(d) and MPEP 506), a Filing Receipt (37 CFR 1.54) will be issued in due course and the date shown on this Acknowledgement Receipt will establish the filing date of the application.

National Stage of an International Application under 35 U.S.C. 371

If a timely submission to enter the national stage of an international application is compliant with the conditions of 35 U.S.C. 371 and other applicable requirements a Form PCT/DO/EO/903 indicating acceptance of the application as a national stage submission under 35 U.S.C. 371 will be issued in addition to the Filing Receipt, in due course.

New International Application Filed with the USPTO as a Receiving Office

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	208764-9006-US02
	Application Number	
Title of Invention	SCANNING SEQUENCE FOR AN INTRA-ORAL IMAGING SYSTEM	

The application data sheet is part of the provisional or nonprovisional application for which it is being submitted. The following form contains the bibliographic data arranged in a format specified by the United States Patent and Trademark Office as outlined in 37 CFR 1.76.
This document may be completed electronically and submitted to the Office in electronic format using the Electronic Filing System (EFS) or the document may be printed and included in a paper filed application.

Secrecy Order 37 CFR 5.2:

☐ Portions or all of the application associated with this Application Data Sheet may fall under a Secrecy Order pursuant to 37 CFR 5.2 (Paper filers only. Applications that fall under Secrecy Order may not be filed electronically.)

Inventor Information:

Inventor 1 Remove

Legal Name

Prefix	Given Name	Middle Name	Family Name	Suffix
	Robert	F.	Dillon	

Residence Information (Select One) ● US Residency Non US Residency Active US Military Service

City	State/Province	Country of Residence
Bedford	NH	US

Mailing Address of Inventor:

Address 1	71 Perry Road
Address 2	
City	Bedford
State/Province	NH
Postal Code	03110
Country	US

Inventor 2 Remove

Legal Name

Prefix	Given Name	Middle Name	Family Name	Suffix
	Craig	A.	Andreiko	

Residence Information (Select One) ◉ US Residency Non US Residency Active US Military Service

City	State/Province	Country of Residence
Deceased		

Mailing Address of Inventor:

Address 1	Deceased
Address 2	
City	
State/Province	
Postal Code	
Country	

Inventor 3 Remove

Legal Name

Prefix	Given Name	Middle Name	Family Name	Suffix
	Andrew	F.	Vesper	

Residence Information (Select One) ◉ US Residency Non US Residency Active US Military Service

PTO/AIA/14 (11-15)
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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	208764-9006-US02
	Application Number	
Title of Invention	SCANNING SEQUENCE FOR AN INTRA-ORAL IMAGING SYSTEM	

City	Townsend	State/Province	MA	Country of Residence	US

Mailing Address of Inventor:

Address 1	1 Granite Rd.		
Address 2			
City	Townsend	State/Province	MA
Postal Code	01469	Country	US

Inventor 4 — Remove

Legal Name

Prefix	Given Name	Middle Name	Family Name	Suffix
	Neil	H.K.	Judell	

Residence Information (Select One) ◉ US Residency ○ Non US Residency ○ Active US Military Service

City	Cambridge	State/Province	MA	Country of Residence	US

Mailing Address of Inventor:

Address 1	36 Lexington Ave.		
Address 2			
City	Cambridge	State/Province	MA
Postal Code	02138	Country	US

Inventor 5 — Remove

Legal Name

Prefix	Given Name	Middle Name	Family Name	Suffix
	Timothy	I.	Fillion	

Residence Information (Select One) ◉ US Residency ○ Non US Residency ○ Active US Military Service

City	Bedford	State/Province	MA	Country of Residence	US

Mailing Address of Inventor:

Address 1	44 Gould Road		
Address 2			
City	Bedford	State/Province	MA
Postal Code	01730	Country	US

All Inventors Must Be Listed - Additional Inventor Information blocks may be generated within this form by selecting the **Add** button. — Add

Correspondence Information:

Enter either Customer Number or complete the Correspondence Information section below.
For further information see 37 CFR 1.33(a).

☐ **An Address is being provided for the correspondence information of this application.**

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	208764-9006-US02
	Application Number	
Title of Invention	SCANNING SEQUENCE FOR AN INTRA-ORAL IMAGING SYSTEM	

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Application Information:

Title of the Invention	SCANNING SEQUENCE FOR AN INTRA-ORAL IMAGING SYSTEM		
Attorney Docket Number	208764-9006-US02	**Small Entity Status Claimed**	☐
Application Type	Nonprovisional		
Subject Matter	Utility		
Total Number of Drawing Sheets (if any)	20	**Suggested Figure for Publication (if any)**	1

Filing By Reference:

Only complete this section when filing an application by reference under 35 U.S.C. 111(c) and 37 CFR 1.57(a). Do not complete this section if application papers including a specification and any drawings are being filed. Any domestic benefit or foreign priority information must be provided in the appropriate section(s) below (i.e., "Domestic Benefit/National Stage Information" and "Foreign Priority Information").

For the purposes of a filing date under 37 CFR 1.53(b), the description and any drawings of the present application are replaced by this reference to the previously filed application, subject to conditions and requirements of 37 CFR 1.57(a).

Application number of the previously filed application	Filing date (YYYY-MM-DD)	Intellectual Property Authority or Country

Publication Information:

☐ Request Early Publication (Fee required at time of Request 37 CFR 1.219)

☐ **Request Not to Publish.** I hereby request that the attached application not be published under 35 U.S.C. 122(b) and certify that the invention disclosed in the attached application **has not and will not** be the subject of an application filed in another country, or under a multilateral international agreement, that requires publication at eighteen months after filing.

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Please Select One:	● Customer Number	US Patent Practitioner	○ Limited Recognition (37 CFR 11.9)
Customer Number	129916		

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Domestic Benefit/National Stage Information:

This section allows for the applicant to either claim benefit under 35 U.S.C. 119(e), 120, 121, 365(c), or 386(c) or indicate National Stage entry from a PCT application. Providing benefit claim information in the Application Data Sheet constitutes the specific reference required by 35 U.S.C. 119(e) or 120, and 37 CFR 1.78.
When referring to the current application, please leave the "Application Number" field blank.

Prior Application Status	Pending		Remove
Application Number	Continuity Type	Prior Application Number	Filing or 371(c) Date (YYYY-MM-DD)
	Continuation of	14/209648	2014-03-13
Prior Application Status	Expired		Remove
Application Number	Continuity Type	Prior Application Number	Filing or 371(c) Date (YYYY-MM-DD)
14/209648	Claims benefit of provisional	61/784535	2013-03-14

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This section allows for the applicant to claim priority to a foreign application. Providing this information in the application data sheet constitutes the claim for priority as required by 35 U.S.C. 119(b) and 37 CFR 1.55. When priority is claimed to a foreign application that is eligible for retrieval under the priority document exchange program (PDX)[i] the information will be used by the Office to automatically attempt retrieval pursuant to 37 CFR 1.55(i)(1) and (2). Under the PDX program, applicant bears the ultimate responsibility for ensuring that a copy of the foreign application is received by the Office from the participating foreign intellectual property office, or a certified copy of the foreign priority application is filed, within the time period specified in 37 CFR 1.55(g)(1).

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Application Number	Country[i]	Filing Date (YYYY-MM-DD)	Access Code[i] (if applicable)

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Statement under 37 CFR 1.55 or 1.78 for AIA (First Inventor to File) Transition Applications

☐ This application (1) claims priority to or the benefit of an application filed before March 16, 2013 and (2) also contains, or contained at any time, a claim to a claimed invention that has an effective filing date on or after March 16, 2013.
NOTE: By providing this statement under 37 CFR 1.55 or 1.78, this application, with a filing date on or after March 16, 2013, will be examined under the first inventor to file provisions of the AIA.

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When this Application Data Sheet is properly signed and filed with the application, applicant has provided written authority to permit a participating foreign intellectual property (IP) office access to the instant application-as-filed (see paragraph A in subsection 1 below) and the European Patent Office (EPO) access to any search results from the instant application (see paragraph B in subsection 1 below).

Should applicant choose not to provide an authorization identified in subsection 1 below, applicant **must opt-out** of the authorization by checking the corresponding box A or B or both in subsection 2 below.

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A. Priority Document Exchange (PDX) - Unless box A in subsection 2 (opt-out of authorization) is checked, the undersigned hereby **grants the USPTO authority** to provide the European Patent Office (EPO), the Japan Patent Office (JPO), the Korean Intellectual Property Office (KIPO), the State Intellectual Property Office of the People's Republic of China (SIPO), the World Intellectual Property Organization (WIPO), and any other foreign intellectual property office participating with the USPTO in a bilateral or multilateral priority document exchange agreement in which a foreign application claiming priority to the instant patent application is filed, access to: (1) the instant patent application-as-filed and its related bibliographic data, (2) any foreign or domestic application to which priority or benefit is claimed by the instant application and its related bibliographic data, and (3) the date of filing of this Authorization. See 37 CFR 1.14(h)(1).

B. Search Results from U.S. Application to EPO - Unless box B in subsection 2 (opt-out of authorization) is checked, the undersigned hereby **grants the USPTO authority** to provide the EPO access to the bibliographic data and search results from the instant patent application when a European patent application claiming priority to the instant patent application is filed. See 37 CFR 1.14(h)(2).

The applicant is reminded that the EPO's Rule 141(1) EPC (European Patent Convention) requires applicants to submit a copy of search results from the instant application without delay in a European patent application that claims priority to the instant application.

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NOTE: Once the application has published or is otherwise publicly available, the USPTO may provide access to the application in accordance with 37 CFR 1.14.

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Applicant Information:

Providing assignment information in this section does not substitute for compliance with any requirement of part 3 of Title 37 of CFR to have an assignment recorded by the Office.

Applicant 1 — Remove

If the applicant is the inventor (or the remaining joint inventor or inventors under 37 CFR 1.45), this section should not be completed. The information to be provided in this section is the name and address of the legal representative who is the applicant under 37 CFR 1.43; or the name and address of the assignee, person to whom the inventor is under an obligation to assign the invention, or person who otherwise shows sufficient proprietary interest in the matter who is the applicant under 37 CFR 1.46. If the applicant is an applicant under 37 CFR 1.46 (assignee, person to whom the inventor is obligated to assign, or person who otherwise shows sufficient proprietary interest) together with one or more joint inventors, then the joint inventor or inventors who are also the applicant should be identified in this section.

Clear

● Assignee	Legal Representative under 35 U.S.C. 117	Joint Inventor
Person to whom the inventor is obligated to assign.	Person who shows sufficient proprietary interest	

If applicant is the legal representative, indicate the authority to file the patent application, the inventor is:

Name of the Deceased or Legally Incapacitated Inventor:

If the Applicant is an Organization check here. ☒

Organization Name	ORMCO CORPORATION		
Mailing Address Information For Applicant:			
Address 1	1717 West Collins Avenue		
Address 2			
City	Orange	**State/Province**	CA
Country	US	Postal Code	92867
Phone Number		Fax Number	
Email Address			

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Assignee Information including Non-Applicant Assignee Information:

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Application Data Sheet 37 CFR 1.76	Attorney Docket Number	208764-9006-US02
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Assignee 1

Complete this section if assignee information, including non-applicant assignee information, is desired to be included on the patent application publication. An assignee-applicant identified in the "Applicant Information" section will appear on the patent application publication as an applicant. For an assignee-applicant, complete this section only if identification as an assignee is also desired on the patent application publication.

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If the Assignee or Non-Applicant Assignee is an Organization check here. ☐

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This Application Data Sheet **must** be signed by a patent practitioner if one or more of the applicants is a **juristic entity** (e.g., corporation or association). If the applicant is two or more joint inventors, this form must be signed by a patent practitioner, **all** joint inventors who are the applicant, or one or more joint inventor-applicants who have been given power of attorney (e.g., see USPTO Form PTO/AIA/81) on behalf of **all** joint inventor-applicants.

See 37 CFR 1.4(d) for the manner of making signatures and certifications.

Signature	/andrew j. paprocki/			Date (YYYY-MM-DD)	2018-10-15
First Name	Andrew	Last Name	Paprocki	Registration Number	60308

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This collection of information is required by 37 CFR 1.76. The information is required to obtain or retain a benefit by the public which is to file (and by the USPTO to process) an application. Confidentiality is governed by 35 U.S.C. 122 and 37 CFR 1.14. This collection is estimated to take 23 minutes to complete, including gathering, preparing, and submitting the completed application data sheet form to the USPTO. Time will vary depending upon the individual case. Any comments on the amount of time you require to complete this form and/or suggestions for reducing this burden, should be sent to the Chief Information Officer, U.S. Patent and Trademark Office, U.S. Department of Commerce, P.O. Box 1450, Alexandria, VA 22313-1450. DO NOT SEND FEES OR COMPLETED FORMS TO THIS ADDRESS. **SEND TO: Commissioner for Patents, P.O. Box 1450, Alexandria, VA 22313-1450.**

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4. A record in this system of records may be disclosed, as a routine use, to a contractor of the Agency having need for the information in order to perform a contract. Recipients of information shall be required to comply with the requirements of the Privacy Act of 1974, as amended, pursuant to 5 U.S.C. 552a(m).

5. A record related to an International Application filed under the Patent Cooperation Treaty in this system of records may be disclosed, as a routine use, to the International Bureau of the World Intellectual Property Organization, pursuant to the Patent CooperationTreaty.

6. A record in this system of records may be disclosed, as a routine use, to another federal agency for purposes of National Security review (35 U.S.C. 181) and for review pursuant to the Atomic Energy Act (42 U.S.C. 218(c)).

7. A record from this system of records may be disclosed, as a routine use, to the Administrator, General Services, or his/her designee, during an inspection of records conducted by GSA as part of that agency's responsibility to recommend improvements in records management practices and programs, under authority of 44 U.S.C. 2904 and 2906. Such disclosure shall be made in accordance with the GSA regulations governing inspection of records for this purpose, and any other relevant (i.e., GSA or Commerce) directive. Such disclosure shall not be used to make determinations about individuals.

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SCANNING SEQUENCE FOR AN INTRA-ORAL IMAGING SYSTEM

RELATED APPLICATIONS

[0001] This application is a continuation of U.S. Patent Application No. 14/209,648, filed March 13, 2014, entitled SCANNING SEQUENCE FOR AN INTRA-ORAL IMAGING SYSTEM, which claims the benefit of U.S. Provisional Patent Application No. 61/784,535, filed March 14, 2013, the entire contents of both of which are incorporated herein by reference.

FIELD

[0002] The disclosure relates to a method, system, and computer readable storage medium for a scanning sequence for an intra-oral imaging system.

BACKGROUND

[0003] An intra-oral imaging system is a diagnostic equipment that allows a dental practitioner to see the inside of a patient's mouth and display the topographical characteristics of teeth on a display unit. Certain three-dimensional (3D) intra-oral imagers may be comprised of an intra-oral camera with a light source. The 3D intra-oral imager may be inserted into the oral cavity of a patient by a dental practitioner. After insertion of the intra-oral imager into the oral cavity, the dental practitioner may capture images of visible parts of the teeth and the gingivae. The 3D intra-oral imager may be fabricated in the form of a slender rod that is referred to as a wand or a handpiece. The wand may be approximately the size of a dental mirror with a handle that is used in dentistry. The wand may have a built-in light source and a video camera that may achieve an imaging magnification, ranging in scale from 1/10 to 40 times or more. This allows the dental practitioner to discover certain types of details and defects of the teeth and gums. The images captured by the intra-oral camera may be displayed on a display unit. Additionally, three-dimensional surfaces generated from images captured (i.e., scanned) by the intra-oral imaging system may be displayed on the display unit.

SUMMARY OF THE PREFERRED EMBODIMENTS

[0004] Provided are a system, method, and computer readable storage medium for generating an intra-oral scan of a dentition. A contiguous scan of an occlusal surface of at least a part of one

arch of the dentition is generated. At least one additional surface is associated to the contiguous scan of the occlusal surface.

[0005] In additional embodiments, the at least one additional surface comprises a plurality of labial surfaces and a plurality of lingual surfaces.

[0006] In further embodiments, each scan of a labial or a lingual surface includes a part of the occlusal surface, where the part of the occlusal surface that is included in each scan of the labial or lingual surface is used to associate the labial or the lingual surface to the contiguous scan of the occlusal surface.

[0007] In yet further embodiments, each scan of the labial or the lingual surface is performed by moving a wand in a predetermined pattern.

[0008] In certain embodiments, the occlusal surface is imaged prior to the plurality of labial and lingual surfaces to display in real-time a three-dimensional representation of the dentition.

[0009] In additional embodiments, the occlusal surface is imaged in a single segment, where the plurality of labial surfaces and the plurality of lingual surfaces are each imaged in a plurality of segments.

[0010] In yet additional embodiments, selected frames of the contiguous scan of the occlusal surface that have an overlap based on an analysis of data, are matched to generate an occlusal backbone.

[0011] In further embodiments, the overlap is based on noise characteristics of the data.

[0012] In additional embodiments, to perform a real-time display of a three-dimensional representation of the dentition, a coarse matching is performed by matching features, prior to a three-dimensional reconstruction based on a point cloud alignment.

[0013] In further embodiments, the occlusal backbone is a first occlusal backbone, and other frames that are different from the selected frames are linked to the occlusal backbone to generate a second occlusal backbone that is more accurate than the first occlusal backbone.

[0014] In certain embodiments, areas representing at least one of a tongue, a cheek, and a lip, are removed from the second occlusal backbone to generate a third occlusal backbone.

[0015] In further embodiments, t le areas representing at least one of the tongue, the cheek, and the lip, are removed from the second occlusal backbone, based on differences in surface normals, color, or rigidity properties.

[0016] In additional embodiments, interferometric fringes are projected on the occlusal surface primarily along an anterior-posterior direction.

[0017] Provided also is an imaging system that comprises a projector that projects interferometric fringes on an occlusal surface of at least a part of one arch of a dentition primarily along an anterior-posterior direction, and an imaging sensor that is used to view the interferometric fringes.

[0018] In certain embodiments, the imaging system is configured to generate a contiguous scan of an occlusal surface, and associate at least one additional surface to the contiguous scan of the occlusal surface. In further embodiments, the at least one additional surface comprises a plurality of labial surfaces and a plurality of lingual surfaces.

BRIEF DESCRIPTION OF THE DRAWINGS

[0019] Referring now to the drawings in which like reference numbers represent corresponding parts throughout:

[0020] FIG. 1 illustrates a block diagram of a computing and imaging environment that includes an intra-oral imaging system used to capture images of a patient's teeth, in accordance with certain embodiments;

[0021] FIG. 2 illustrates a diagram that shows scanning of a dental arch, in accordance with certain embodiments;

[0022] FIG. 3 illustrates a diagram that shows how lingual and labial scans are associated with an occlusal backbone to generate a three-dimensional surface representation of a dental arch, in accordance with certain embodiments;

[0023] FIG. 4 illustrates a flowchart that shows how labial and lingual scans are attached to an occlusal backbone to display a three-dimensional reconstruction of the dental arch, in accordance with certain embodiments;

[0024] FIG. 5 illustrates a diagram that shows interferometric fringes projected on a dental arch, in accordance with certain embodiments;

[0025] FIG. 6 illustrates an exemplary sequence of occlusal frames, in accordance with certain embodiments;

[0026] FIG. 7 illustrates a diagram that shows how selected frames with an exemplary 50% overlap are used to construct the occlusal backbone, in accordance with certain embodiments;

[0027] FIG. 8 illustrates a diagram that shows how frames are matched to construct the occlusal backbone, in accordance with certain embodiments;

[0028] FIG. 9 illustrates a diagram that shows a representation of an occlusal scan with tongue, lips, and cheek, in accordance with certain embodiments;

[0029] FIG. 10 illustrates a diagram that shows how tongue, lips, and cheek are removed from the occlusal backbone, in accordance with certain embodiments;

[0030] FIG. 11 illustrates a diagram that shows the movement of a wand in an exemplary pattern for labial or lingual scans, in accordance with certain embodiments;

[0031] FIG. 12 illustrates a first phase of an exemplary surface reconstruction of a plurality of teeth by stitching first and second segments of a labial surface to an occlusal backbone, in accordance with certain embodiments;

[0032] FIG. 13 illustrates a second phase of an exemplary surface reconstruction of a plurality of teeth by stitching a third segment a labial surface and a first segment of a lingual surface to an occlusal backbone, in accordance with certain embodiments;

[0033] FIG. 14 illustrates a third phase of an exemplary surface reconstruction of a plurality of teeth by stitching second and a third segments of a lingual surface to an occlusal backbone, in accordance with certain embodiments;

[0034] FIG. 15 illustrates a flowchart that shows how an accurate occlusal backbone is generated by selecting frames that overlap, and by removing areas that represent the tongue, cheek, and lips, and how labial and lingual scans are attached to the occlusal backbone to display a three-dimensional reconstruction of the dental arch, in accordance with certain embodiments;

[0035] FIG. 16 illustrates a flowchart that shows how labial and lingual scans are attached to an occlusal backbone to display a three-dimensional reconstruction of the dental arch, in accordance with certain embodiments;

[0036] FIG. 17 illustrates a flowchart that shows how labial and lingual scans obtained by moving a wand in an exemplary pattern are associated with an occlusal backbone to display a three-dimensional reconstruction of the dental arch in accordance with certain embodiments;

[0037] FIG. 18 illustrates a flowchart that shows how at least one additional surface is associated with a contiguous scan of an occlusal surface, in accordance with certain embodiments;

[0038] FIG. 19 illustrates a flowchart that shows how a plurality of labial and lingual surfaces are associated with a contiguous scan of an occlusal surface, in accordance with certain embodiments; and

[0039] FIG. 20 illustrates a block diagram of a computational device that may correspond to the intra-oral imaging device shown in FIG. 1, in accordance with certain embodiments.

DETAILED DESCRIPTION

[0040] In the following description, reference is made to the accompanying drawings which form a part hereof and which illustrate several embodiments. It is understood that other embodiments may be utilized and structural and operational changes may be made.

Using an Intra-Oral Imaging System for Scanning a Dental Arch

[0041] A dental practitioner may insert a wand of the intra-oral imaging system into a patient's oral cavity to acquire images of the patient's teeth. In certain embodiments, the dental practitioner first acquires an occlusal scan of the patient's teeth in a single segment via an uninterrupted motion of the wand over the occlusal surface of the teeth. While performing the occlusal scan the wand may rest on the teeth and glide smoothly over the dental arch.

[0042] Subsequent to performing the occlusal scan, the dental practitioner may use the wand to acquire images of each of the lingual and labial surfaces of the dental arch in a plurality of segments. The presence of lips, tongue, cheek, etc., makes it difficult to acquire images of the lingual and labial surface via an uninterrupted motion of the wand and therefore each of the lingual and labial surfaces are imaged in multiple segments.

[0043] In certain embodiments, the frames of the occlusal scan are merged into an occlusal backbone to which the segments of the lingual and labial surfaces are linked to generate a three-dimensional surface of the dental arch that is displayed in real-time on a display device.

[0044] The occlusal backbone is generated in multiple phases. In a first phase, in order to statistically limit the effect of random noise and other image characteristics, selected frames that overlap by about 50% (or some other percentage) are stitched to form a rough occlusal backbone and then other frames are stitched to the rough occlusal backbone. Subsequently, areas representing tongue, cheek, and lips are removed from the occlusal backbone, and a restitching of frames is performed to generate a more accurate occlusal backbone. The segments of lingual and labial surfaces are then acquired by moving the wand in an exemplary pattern, such as, in the pattern of a hook. In each segment of the lingual and labial surface that is acquired, the movement of the wand in the exemplary pattern ensures that part of the occlusal scan is also acquired. The part of the occlusal scan that is acquired is used to match the segments of the lingual and labial surfaces to the occlusal backbone, and the three-dimensional surface of the dental arch is displayed on the display device.

[0045] The embodiments allow generation of a more accurate three-dimensional surface of the dental arch for real-time display, in comparison to situations in which a contiguous occlusal scan is not used.

Exemplary Embodiments

[0046] FIG. 1 illustrates a block diagram of a computing and imaging environment 100 that includes an intra-oral imaging system 102 used to capture images of a patient's teeth 103, in accordance with certain embodiments.

[0047] The intra-oral imaging system 102 is comprised of a processor 104, a display unit 106, a wand 108, and a scanning and surface reconstruction application 110. In certain embodiments, the intra-oral imaging system 102 may be coupled via a wired or wireless connection over a network to one or more computational devices (not shown), where the computational devices may include any suitable computational device such as a personal computer, a server computer, a mini computer, a mainframe computer, a blade computer, a tablet computer, a touch screen computing device, a telephony device, a cell phone, a mobile computational device, etc., and some of the computational devices may provide web services or cloud computing services.

[0048] A dental practitioner may hold the wand 108 inside a patient's oral cavity. An optical source (e.g. the projector 105) included in the wand 108 or coupled to the wand 108, may illuminate the oral cavity and the intra-oral imaging sensor 112 may be used to capture a plurality of digital images of structures in the oral cavity, such as the patient's teeth, gingivae, and/or, palate, and other structures, such as fillings, braces, etc. In certain embodiments the intra-oral imaging sensor 112 may comprise an intra-oral camera.

[0049] The operation of the wand 108 may be controlled by the scanning and surface reconstruction application 110 that may be implemented in software, hardware, firmware or any combination thereof. In certain embodiments, the display unit 106 of the intra-oral imaging system 104 may include a touch screen display unit that displays scanning sequence prompts 114 and three-dimensional surface reconstructions 116 of the patient's dental arches. The scanning and surface reconstruction application 110 may process the images acquired by the intra-oral

imaging sensor 112 and also display the images on the display unit 106 and further transmit the images to one or more computational devices coupled via a network to the intra-oral imaging system 102.

[0050] The patient's teeth 103 that are imaged via the intra-oral imaging system 102 may include a mandibular arch 118 and a maxillary arch 120. Each of the mandibular arch 118 and the maxillary arch 120 may include an occlusal surface 122, 124, a labial surface 126, 128 and a lingual surface 130, 132.

[0051] Therefore, FIG. 1 illustrates certain embodiments in which an intra-oral imaging system 102 is used to acquire intra-oral images of the occlusal, labial, and lingual surfaces of the maxillary and mandibular arch of a patient. In the process of acquisition of images, the occlusal surface of a dental arch is acquired first via a single uninterrupted motion of the wand 108, followed by the labial and the lingual surfaces that are acquired in multiple segments. An occlusal backbone is generated from the image frames of the occlusal scan, and then the segments of the labial and lingual scans are linked to the occlusal backbone to generate the three-dimensional surface of the dental arch for real-time display on the display unit 106.

[0052] FIG. 2 illustrates a diagram 200 that shows scanning of a dental arch, in accordance with certain embodiments. An exemplary occlusal scan 202 that is generated by gliding the wand 108 over the occlusal surface of a dental arch 118, 120 of the patient is shown. The viewing orientation of the intra-oral imaging sensor 112 for labial scan (shown via reference numeral 204) and the viewing orientation of intra-oral imaging sensor 112 for lingual scan (shown via reference numeral 206) are also shown. In the lingual scan, the side surfaces of the teeth that are predominantly faced towards the tongue are imaged. In the labial scan the side surfaces of the teeth that are predominantly faced towards the lips and cheek are imaged.

[0053] FIG. 3 illustrates a diagram 300 that shows how lingual and labial scans are associated with an occlusal backbone to generate a three-dimensional surface representation of a dental arch, in accordance with certain embodiments.

[0054] A representation of an occlusal backbone that is constructed from a contiguous occlusal scan is shown via reference numeral 302. An exemplary segment of a labial scan 304

and an exemplary segment of a lingual scan 306 are also shown. It may be noted that multiple segments of labial scan and lingual scan may be needed to cover the entire dental arch.

[0055] In certain embodiments, the segments of the labial scan 304 and the segments of the lingual scan 306 are attached (reference numerals 308, 310) to the occlusal backbone 302 to generate a three-dimensional surface representation of the dental arch 312.

[0056] Therefore, FIG. 3 illustrates certain embodiments in which segments of labial and lingual scans are attached to an occlusal backbone to generate a three-dimensional surface representation of the dental arch for display on the display unit 106 of the infra-oral imaging system 102.

[0057] FIG. 4 illustrates a flowchart 400 that shows how labial and lingual scans are attached to an occlusal backbone to display a three-dimensional reconstruction of the dental arch, in accordance with certain embodiments. The operations shown in FIG. 4 may be performed via the scanning and surface reconstruction application 110 that executes operations on the processor 104 of the intra-oral imaging system 102. In certain alternative embodiments, the operations shown in FIG. 4 may be performed in one or more computational devices that are external to the intra-oral imaging system 102.

[0058] Control starts at block 402 in which the scanning and surface reconstruction application 110 generates a contiguous scan of the occlusal surface of a dental arch of the patient. A contiguous scan is a scan that scans a part or the entirety of the dental arch in a single uninterrupted motion of the wand. For example, in certain embodiments a dental practitioner may place the wand on the occlusal surface of a patient's tooth on the last molar (i.e., third molar) at one end of the dental arch and glide the wand over the occlusal surface to the last molar (i.e., third molar) on the other end of the dental arch in about 30 seconds and the corresponding scanning may be an example of a contiguous scan. It should be noted that the contiguous scan need not scan the entirety of the dental arch, but may scan a part of the dental arch. Hundreds or thousands of image frames may be acquired during the scanning process, where each image frame may be an image of a part of a tooth, an image of one tooth, or an image of a few teeth of the dental arch. Successive frames may have overlapping regions of the occlusal surface.

[0059] Control proceeds to block 404, where the hundreds or thousands of image frames are used to generate an occlusal backbone which is a three dimensional surface representation of the occlusal surface.

[0060] From block 404, control may proceed either to block 406 or block 408, where either block 406 may be performed before block 408, or block 408 may be performed before block 406.

[0061] At block 406, a plurality of labial scan segments are generated by moving the wand 108 in a hook shaped pattern (or some other exemplary pattern) to periodically image a portion of the occlusal surface while imaging the labial surface. For example, the wand 108 is moved to image the occlusal surface of a first tooth (e.g., the last, i.e., third molar at the end of a dental arch), and moved down the side surface of the first tooth towards the labial side and then along the side surface of the first tooth, second tooth, and third tooth to image a portion of the labial surface. Then the wand 108 is moved up the side surface of the third tooth and part of the occlusal surface of the third tooth is imaged to complete the scanning of a first segment of a labial surface. After that the wand 108 is gripped differently and after scanning part of the occlusal surface of the third tooth the wand 108 is moved down to the side surface of the third tooth, and the wand 108 continues to image the side surface of the third tooth, a fourth tooth, a fifth tooth along the labial surface before being moved up to scan the occlusal surface of the fifth tooth to complete the scanning of a second segment of the labial surface. Therefore, via a hook shaped or other movement pattern, at least a segment (e.g., spanning 2-6 teeth or more) of a labial scan is obtained. In alternative embodiments, other exemplary patterns besides a hook shaped pattern may be used for the movement of the wand 108. Since the wand 108 may have to be regripped (i.e., gripped in different ways) while capturing images of the labial and lingual surfaces, the scanned images of the lingual and labial surfaces may be captured in multiple segments. Each segment corresponds to images captured in a single uninterrupted movement of the wand. From block 406, control proceeds to block 410 where the labial scan segments are attached to the occlusal backbone.

[0062] At block 408, a plurality of lingual scan segments are generated by moving the wand 108 in a hook shaped pattern (or other exemplary pattern) to periodically image a portion of the

occlusal surface. The plurality of lingual scan segments are attached to the occlusal backbone (at block 412).

[0063] After the labial scan segments and the lingual scan segments have all been attached to the occlusal backbone (at blocks 410, 412) then control proceeds to block 414 where the three-dimensional reconstruction of the dental arch is displayed on the display unit 106.

[0064] Therefore FIG. 4 illustrates a flowchart that shows how labial and lingual segments are attached to an occlusal backbone to display a three-dimensional surface reconstruction of a dental arch.

[0065] FIG. 5 illustrates a diagram 500 that shows interferometric fringes 502 projected by a projector 105 on a dental arch, in accordance with certain embodiments. In certain embodiments, the intra-oral imaging system 102 is a precision opto-mechanical device, based on accordion fringe interferometer (AFI) techniques that measure three dimensional points on an object surface. The AFI technology projects (via the projector 105) two coherent beams of light, which create a precision interference fringe pattern visible on an object surface. In a simple single channel AFI system, a series of three two dimensional fringe images are acquired by an off-axis camera, with the fringe pattern at 0°, +120°, and -120°. For each camera pixel, the relative intensities of the three measurements may be mathematically combined to calculate a unique distance to the object surface, with the measurement limited by the width of one fringe. A multi-channel AFI system is not limited to a measurement width of one fringe, and is, therefore, capable of rapidly measuring the topology of intra-oral features.

[0066] In FIG. 5, the wand is moved along the line 504 shown superimposed on the dental arch on which the interferometric fringes are projected. It may be observed that the movement of the wand is predominantly along the direction in which the interferometric fringes are projected. As a result, the error in surface reconstruction of the occlusal surface is reduced, in comparison to situations where interferometric fringes are not aligned with the predominant direction of the translational motion of the wand 108.

[0067] Therefore, FIG. 5 illustrates certain embodiments in which interferometric fringes are projected on the occlusal surface primarily along a direction in which the contiguous scan of the

occlusal surface is performed, to reduce the amount of error in generating three-dimensional occlusal surfaces. FIG. 5 illustrates certain embodiments of an imaging system 102, comprising a projector 105 that projects interferometric fringes on an occlusal surface of at least a part of one arch of a dentition primarily along an anterior-posterior direction, and an imaging sensor 112 that is used to view the interferometric fringes. In certain embodiments, the imaging system 102 is configured to generate a contiguous scan of an occlusal surface, and associate at least one additional surface to the contiguous scan of the occlusal surface. In certain embodiments, the at least one additional surface comprises a plurality of labial surfaces and a plurality of lingual surfaces.

[0068] FIG. 6 illustrates an exemplary sequence 600 of occlusal frames, in accordance with certain embodiments. The occlusal frames F1, F2, F3, F4, F5, F6, F7, F8, F9, F10, F11 (shown via reference numeral 602) are acquired successively while traversing the occlusal surface of the dental arch, and each occlusal frame encompasses part of a tooth, a single tooth, or a plurality of teeth. There is overlap of the occlusal surface between two successive frames. For example, both frame F1 and frame F2 may image a section of the same tooth.

[0069] In certain embodiments, to minimize the effects of noise and certain other image characteristics, frames which overlap by about 50% are selected to construct the occlusal backbone. In other embodiments, frames with a different percentage of overlap may be selected to construct the occlusal backbone. In situations where the noise is random, an overlap of about 50% between two flumes may provide adequate translational movement and not too much rotational movement to tit the two frames to each other via a process of statistical noise elimination. In other embodiments frames may be selected based on an overlap that may vary between 15% to 85%. In other embodiments, the optimal percentage of overlap may be determined based on analysis of data included or associated with the frames. In certain embodiments, the optimal percentage for the overlap may depend of the noise characteristics.

[0070] For example, FIG. 6 shows that frames F1, F4, F7, and F10 are selected to be stitched together (i.e., to be fitted during surface reconstruction) in a first phase of the construction of the occlusal backbone. Frames F4 and F1 have an overlapping region of about 50%, frames F7 and

F4 have an overlapping region of about 50%, and frames F7 and F10 have an overlapping region of about 50%.

[0071] FIG. 7 illustrates a diagram 700 that shows how selected frames with around 50% overlap are used to construct the occlusal backbone, in accordance with certain embodiments.

[0072] In FIG. 7 that is based on the frames F1 . . . F11 shown via, reference numeral 602 in FIG. 6, Frames F4 and F1 have an overlapping region of about 50%, frames F7 and F4 have an overlapping region of about 50%, and these frames F1, F4, F7 are stitched together in a first phase (shown via reference numeral 702) to generate a rough occlusal backbone. Then in a second phase frames F2, F3, F5, F6 are attached (shown via, reference numeral 704) to the rough occlusal backbone to generate a more accurate occlusal backbone.

[0073] FIG. 8 illustrates a diagram 800 that shows how frames are matched to construct the occlusal backbone, in accordance with certain embodiments. Frame P 802 has an associated feature list 803 and a point cloud 804 of about 7500 points, and frame Q 806 has an associated feature list 808 and a point cloud 810 of about 75000 points. Matching frame P 802 to frame Q 806 in three dimensions, by using the roughly 75000 point cloud pairs is very time consuming. To display the three-dimensional surface reconstruction in real-time while scanning is being performed, the feature lists 803 and 808 are used to match frame P 802 to frame Q 806 and perform a coarse matching (block 812). The feature lists 802, 808 are relatively faster to match. Once a coarse matching is obtained, then a point cloud alignment may be performed with the point clouds 804, 810 or other mechanisms may be used to refine the match as shown via reference numeral 813, to perform (at block 814) the three-dimensional reconstruction.

[0074] Therefore, FIGs. 6, 7, and 8 illustrate certain embodiments in which an occlusal backbone is constructed by first using frames that overlap by about 50% (or on some other percentage based on noise or other characteristics), and then other frames are attached to the occlusal backbone. During construction of the optical backbone frames are first matched via matching feature lists to secure coarse fits, before using point clouds to refine the fitting of frames for three-dimensional surface reconstruction.

[0075] FIG. 9 illustrates a diagram 900 that shows a representation of an occlusal scan 902 with tongue 904, lips 906, and cheek 908, in accordance with certain embodiments. The tongue, lips, and cheek may hide portions of the occlusal surface of the dental arch when the occlusal scan of the dental arch is being acquired. The frames of the occlusal scan shows images of the teeth overlapped with portions of the tongue, lips, and cheek, and potentially other elements. The portions that represent the tongue, cheek, and lips are removed from the occlusal backbone.

[0076] FIG. 10 illustrates a diagram 100 that shows how tongue, lips, and cheek are removed from the occlusal backbone, in accordance with certain embodiments. In FIG. 10 an exemplary tooth 1002 and cheek 1004 are shown. It can be observed that the surface normals 1006 of the tooth 1002 are oriented significantly differently than the surface normals 1008 of the cheek 1004. Additionally, if color images are taken there may be color differences between the tooth and cheek. Since cheek is non-rigid and tooth is rigid, image characteristics in a sequence of frames may be used to determine non-rigid objects like cheek (or lips or tongue). Therefore, by determining one or more of surface normal differences 1010, color differences 1012, rigidity property differences 1014, and other cues 1016 the areas of the occlusal scan that represent cheek, tongue, and lips are removed from the occlusal backbone.

[0077] FIG. 11 illustrates a diagram 1100 that shows the movement of a wand 108 in an exemplary pattern, such as in a hook shaped pattern, for labial or lingual scans, in accordance with certain embodiments. Other predetermined movement patterns besides a hook shaped pattern may be used in alternative embodiments.

[0078] In FIG. 11, the wand may be placed on the occlusal surface of a first tooth (e.g., the third molar at the end of a dental arch), and moved down (reference numeral 1102) the side surface of the first tooth towards the labial side and then along (reference numeral 1104) the side surface of the first tooth, a second tooth, and a third tooth to image a portion of the labial surface. Then the wand is moved up (reference numeral 1106) the side surface of the third tooth and part of the occlusal surface of the third tooth is imaged. Therefore reference numerals 1102, 1104, 1106 show a first segment being acquired for a labial scan.

[0079] Subsequent to the first segment being acquired for a labial scan, the wand may have to be gripped once again, and after scanning part of the occlusal surface of the third tooth, the

wand is moved down (reference numeral 1108) to the side surface of the third tooth and the wand continues to image the side surface of the third tooth, a fourth tooth, a fifth tooth along (reference numeral 1110) the labial surface before being moved up (reference numeral 1112) to scan the occlusal surface of the fifth tooth. Therefore reference numerals 1108, 1110, 1112 show a second segment being acquired for a labial scan.

[0080] Therefore, via a hook shaped movement pattern at least a segment (e.g., spanning 2-6 teeth or more) of a labial scan is obtained. Multiple segments of labial scan and multiple segments of lingual scan are generated to image the dental arch.

[0081] Therefore, FIG. 11 shows certain embodiment, in which by moving the wand 108 in a hook shaped pattern or in accordance with other predetermined patterns, a plurality of segments of the labial and lingual surfaces are obtained, where each segment also includes portions of the occlusal surface that may be used to map the lingual and labial segments to the occlusal backbone. In certain embodiments, both the labial and lingual surfaces have three or four segments each. In other embodiments, the labial and lingual surfaces may be captured in a different number of segments.

[0082] FIG. 12 illustrates a first phase 1200 of an exemplary surface reconstruction of a plurality of teeth by stitching first and second segments of a labial surface to an occlusal backbone, in accordance with certain embodiments. An occlusal surface of the mandibular arch 1202 represented via the occlusal backbone is shown and the first segment 1204 of the labial surface is stitched (i.e., mapped and fitted) to the occlusal backbone. Then the second segment of the labial surface 1206 is fitted to the occlusal backbone and the first segment.

[0083] FIG. 13 illustrates a second phase 1300 of an exemplary surface reconstruction of a plurality of teeth by stitching a third segment a labial surface and a first segment of a lingual surface to an occlusal backbone, in accordance with certain embodiments. An occlusal surface of the mandibular arch represented via the occlusal backbone 1202 is shown and the third segment of the labial surface 1302 is stitched (i.e., mapped and fitted) to the occlusal backbone and the second segment of the labial surface. Thus the labial surface is completely fitted to the occlusal surface. Then the first segment of the lingual surface 1304 is fitted to the occlusal backbone.

[0084] FIG. 14 illustrates a third phase 1400 of an exemplary surface reconstruction of a plurality of teeth by stitching second and third segments of a lingual surface to an occlusal backbone, in accordance with certain embodiments. An occlusal surface of the mandibular arch represented via the occlusal backbone 1202 is shown and a second segment of the lingual surface 1402 is stitched (i.e., mapped and fitted) to the occlusal backbone and the first segment of the lingual surface. Then the third segment of the lingual surface 1404 is fitted to the occlusal backbone and the second segment of the lingual surface. As a result all segments of the lingual and labial surfaces are fitted to the occlusal backbone and the three dimensional surface reconstruction of the dental arch is completed.

[0085] FIG. 15 illustrates a flowchart 1500 that shows how an accurate occlusal backbone is generated by selecting frames that overlap by a determined amount (e.g., 50% overlap) and by removing areas that represent the tongue, cheek, and lips, and how labial and lingual scans are attached to the occlusal backbone to display a three-dimensional reconstruction of the dental arch, in accordance with certain embodiments. The operations shown in FIG. 15 may be performed via the scanning and surface reconstruction application 110 that executes operations on the processor 104 of the intraoral imaging system 102. In certain alternative embodiments, the operations shown in FIG. 15 may be performed in one or more computational devices that are external to the intra-oral imaging system 102.

[0086] Control starts at block 1502 in which the intraoral imaging system 102 scans a sequence of frames in an occlusal scan of the dental arch. Frames with an overlap (e.g., 50% overlap) that are determined based on analysis of data are stitched, i.e., fitted, (at block 1504) to generate a first phase occlusal backbone. The intra-oral imaging system 102 fills (at block 1506) the other frames (e.g., the frames that did not have around 50% overlap) to the first phase occlusal backbone to generate a second phase occlusal backbone.

[0087] The intra-oral imaging system 102 removes (at block 1508) the tongue, cheek, lips and other extraneous data from the second phase occlusal backbone. Control proceeds to block 1510 in which the frames with an overlap (e.g., 50% overlap) based on the analysis of date are stitched once again to generate a third phase occlusal backbone. This restitching is relatively fast as it can start with positions and orientations determined in the second phase occlusal backbone

which are fairly accurate, and the new positions and orientations are a minor deviation from the previous positions and orientations. The other frames are filled in the third phase occlusal backbone to generate a fourth phase occlusal backbone. It should be noted that the fourth phase occlusal backbone is more accurate in position and orientation and does not have tongue, cheek, or lip data.

[0088] The wand 108 of the intra-oral imaging system is used to scan (at blocks 1514 and 1516) labial and lingual segments in a hook shaped or some other pattern that periodically overlaps the occlusal surface. From blocks 1514 and 1516 control proceeds to block 1518 in which the intra-oral imaging system 102 stitches lingual and labial segments to the fourth phase occlusal backbone and displays (at block 1520) the three-dimensional surface of dental arch on the display unit 106.

[0089] FIG. 16 illustrates a flowchart 1600 that shows how labial and lingual scans are attached to an occlusal backbone to display a three-dimensional reconstruction of the dental arch, in accordance with certain embodiments. The operations shown in FIG. 16 may be performed via the scanning and surface reconstruction application 110 that executes operations on the processor 104 of the intra-oral imaging system 102. In certain alternative embodiments, the operations shown in FIG. 16 may be performed in one or more computational devices that are external to the intra-oral imaging system 102.

[0090] Control starts at block 1602 in which the wand 108 is used to image an occlusal surface of a plurality of teeth of the dental arch of the patient. A plurality of labial surfaces and a plurality of lingual surfaces of the plurality of teeth of the dental arch of the patient are also imaged (at block 1604).

[0091] The scanning and surface reconstruction application 110 stitches (at block 1606) the plurality of imaged labial and images lingual surfaces to the imaged occlusal surface. A digital surface representation of the plurality of teeth based on the stitching of the plurality of imaged labial surfaces and the plurality of imaged lingual surfaces to the imaged occlusal surface is generated (at block 1608).

[0092] FIG. 17 illustrates a flowchart 1700 that shows how labial and lingual scans obtained by moving a wand 108 in a hook shaped or some other pattern are associated with an occlusal backbone to display a three-dimensional reconstruction of the dental arch, in accordance with certain embodiments. The operations shown in FIG. 17 may be performed via the scanning and surface reconstruction application 110 that executes operations on the processor 104 of the intra-oral imaging system 102. In certain alternative embodiments, the operations shown in FIG. 17 may be performed in one or more computational devices that are external to the intra-oral imaging system 102.

[0093] Control starts at block 1702 in which a contiguous scan of an occlusal surface of one arch of a dentition is generated, where dentition refers to the arrangement of teeth n the oral cavity of a patient. Labial and lingual surfaces are scanned (at block 1704) in multiple segments by moving the wand 108 in a hook shaped or some other pattern to include areas of the occlusal surface.

[0094] Control proceeds to block 1706 in which the scanning and surface reconstruction application 110 associates a plurality of labial surfaces of the one arch and a plurality of lingual surfaces of the one arch, to the contiguous scan of the occlusal surface. The contiguous scan of the occlusal surface is therefore used to generate a three-dimensional representation of the dentition.

[0095] FIG. 18 illustrates a flowchart 1800 that shows how at least one additional surface is associated with a contiguous scan of an occlusal surface, in accordance with certain embodiments. The operations shown in FIG. 18 may be performed via the scanning and surface reconstruction application 110 that executes operations on the processor 104 of the intra-oral imaging system 102. In certain alternative embodiments, the operations shown in FIG. 18 may be performed in one or more computational devices that are external to the intra-oral imaging system 102.

[0096] Control starts at block 1802 in which a contiguous scan of an occlusal surface of at least a part of one arch of the dentition is generated. Control proceeds to block 1804 in which at least one additional surface is associated with the contiguous scan of the occlusal surface.

[0097] FIG. 19 illustrates a flowchart 1900 that shows how a plurality of labial and lingual surfaces are associated with a contiguous scan of an occlusal surface, in accordance with certain embodiments. The operations shown in FIG. 19 may be performed via the scanning and surface reconstruction application 110 that executes operations on the processor 104 of the intra-oral imaging system 102. In certain alternative embodiments, the operations shown in FIG. 19 may be performed in one or more computational devices that are external to the intra-oral imaging system 102.

[0098] Control starts at block 1902 in which a contiguous scan of an occlusal surface of at least a part of one arch of the dentition is generated. Control proceeds to block 1904 in which a plurality of labial surfaces and a plurality of lingual surfaces are associated with the contiguous scan of the occlusal surface.

[0099] Therefore, FIGs. 1-19 illustrate certain embodiments in which an occlusal backbone of a dental arch is generated from an contiguous occlusal scan, and then segments of labial and lingual surfaces are stitched to the occlusal backbone to generate a three-dimensional surface representation of the dental arch. The operations may be performed in real time via feature matching to generate a coarse match prior to using point clouds or other mechanisms for matching. Additionally, tongue, cheek, and lip data are removed to secure a more accurate occlusal backbone. The generation of the occlusal backbone prior to the labial and lingual scans facilitates the generation of a more accurate three dimensional representation of a dental arch in comparison to the situation in which the occlusal backbone is not generated. In certain embodiments, holes may be filled after the three-dimensional surface of the dental arch has been constructed. In other embodiments, image compression may be achieved during a statistical noise elimination process achieved by constructing a rough occlusal backbone with only those frames that overlap by around 50% or by some other percentage.

Additional Details of Embodiments

[0100] The operations described in the figures may be implemented as a method, apparatus or computer program product using techniques to produce software, firmware, hardware, or any combination thereof. Additionally, certain embodiments may take the form of a computer

program product embodied in one or more computer readable storage medium(s) having computer readable program code embodied therein.

[0101] A computer readable storage medium may include an electronic, magnetic, optical, electromagnetic, or semiconductor system, apparatus, or device, or any suitable combination of the foregoing. The computer readable storage medium may also comprise an electrical connection having one or more wires, a portable computer diskette or disk, a hard disk, a random access memory (RAM), a read-only memory (ROM), an erasable programmable read-only memory (EPROM or Flash memory), a portable compact disc read-only memory (CD-ROM), an optical storage device, a magnetic storage device, etc. A computer readable storage medium may be any tangible medium that can contain, or store a program for use by or in connection with an instruction execution system, apparatus, or device.

[0102] A computer readable signal medium includes a propagated data signal pith computer readable program code embodied therein. A computer readable signal medium may be any computer readable medium that is not a computer readable storage medium and that can communicate, propagate, or transport a program for use by or in connection with an instruction execution system, apparatus, or device. The computer readable storage medium is different from the computer readable signal medium.

[0103] Computer program code for carrying out operations for aspects of the present invention may be written in any combination of one or more programming languages.

[0104] Aspects of the present invention are described below with reference to flowchart illustrations and/or block diagrams of methods, system and computer program products according to certain embodiments. At least certain operations that may have been illustrated in the figures show certain events occurring in a certain order. In alternative embodiments, certain operations may be performed in a different order, modified or removed. Additionally, operations may be added to the above described logic and still conform to the described embodiments. Further, operations described herein may occur sequentially or certain operations may be processed in parallel. Yet further, operations may be performed by a single processing unit or by distributed processing units. Computer program instructions can implement the blocks of the

flowchart. These computer program instructions may be provided to a processor of a computer for execution.

[0105] FIG. 20 illustrates a block diagram that shows certain elements that may be included in a computational device 2000, where in the computational device 2000 may be the infra-oral imaging system 102, in accordance with certain embodiments. The system 2000 may include a circuitry 2002 that may in certain embodiments include at least a processor 2004. The processor 2004 may comprise any suitable processor known in the art, such as, an arithmetic logical unit, a central processing unit, a circuitry that perform operations, hardware that performs instructions of a computer program, a microprocessor, a parallel processor, an array processor, a vector processor, a transistorized central processing unit, a microcontroller, a logic circuitry, etc. Any device that manipulates digital information based on one or more operational instructions or in a predefined manner is an example of the processor 2004. The system 2000 may also include a memory 2006 (e.g., a volatile memory device), and storage 2008. The storage 2008 may include a. non-volatile memory device (e.g., EEPROM. ROM, PROM. RAM, DRAM, SRAM, flash, firmware, programmable logic, etc.), magnetic disk drive, optical disk drive, tape drive, etc. The storage 2008 may comprise an internal storage device, an attached storage device and/or a network accessible storage device. The system 2000 may include a program logic 2010 including code 2012 that may be loaded into the memory 2006 and executed by the processor 2004 or circuitry 2002. In certain embodiments, the program logic 2010 including code 2012 may be stored in the storage 2008. In certain other embodiments, the program logic 2010 may be implemented in the circuitry 2002. Therefore, while FIG. 20 shows the program logic 2010 separately from the other elements, the program logic 2010 may be implemented in the memory 2006 and/or the circuitry 2002.

[0106] The terms "an embodiment", "embodiment", "embodiments", "the embodiment", "the embodiments". "one or more embodiments", "some embodiments", and "one embodiment" mean "one or more (but not all) embodiments of the present invention(s)" unless expressly specified otherwise.

[0107] The terms "including", "comprising", "having" and variations thereof mean "including but not limited to", unless expressly specified otherwise.

[0108] The enumerated listing of items does not imply that any or all of the items are mutually exclusive, unless expressly specified otherwise.

[0109] The terms "a", "an" and "the" mean "one or more ", unless expressly specified otherwise.

[0110] Devices that are in communication with each other need not be in continuous communication with each other, unless expressly specified otherwise. In addition, devices that are in communication with each other may communicate directly or indirectly through one or more intermediaries.

[0111] A description of an embodiment with several components in communication with each other does not imply that all such components are required. On the contrary a variety of optional components are described to illustrate the wide variety of possible embodiments.

[0112] When a single device or article is described herein, it will be readily apparent that more than one device/article (whether or not they cooperate) may be used in place of a single device/article. Similarly, where more than one device or article is described herein (whether or not they cooperate), it will be readily apparent that a single device/article may be used in place of the more than one device or article or a different number of devices/articles may be used instead of the shown number of devices or programs. The functionality and/or the features of a device may be alternatively embodied by one or more other devices which are not explicitly described as having such functionality/features.

[0113] The foregoing description of various embodiments of the invention has been presented for the purposes of illustration and description. It is not intended to be exhaustive or to limit the invention to the precise form disclosed. Many modifications and variations are possible in light of the above teaching. It is intended that the scope of the invention be limited not by this detailed description, but rather by the claims appended hereto. The above specification, examples and data provide a complete description of the manufacture and use of the composition of the invention. Since many embodiments of the invention can be made without departing from the spirit and scope of the invention, the invention resides in the claims hereinafter appended.

CLAIMS

What is claimed is:

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

a memory; and

a processor coupled to the memory, wherein the processor is configured to:

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

associate a scan of at least one additional surface to the contiguous scan of the occlusal surface.

2. The system of claim 1, wherein the scan of the at least one additional surface comprises a plurality of scans of labial surfaces and a plurality of scans of lingual surfaces.

3. The system of claim 2, wherein each scan of a labial or lingual surface includes a part of the occlusal surface, and wherein the processor is configured to use the part of the occlusal surface that is included in each scan of the labial or lingual surface to associate the labial or lingual surface to the contiguous scan of the occlusal surface.

4. The system of claim 2, wherein the occlusal surface is imaged prior to the plurality of labial and lingual surfaces, and wherein the processor is further configured to display in real-time a three-dimensional representation of the dentition as the plurality of labial and lingual surfaces are imaged.

5. The system of claim 4, wherein the processor is configured to display in real-time the three-dimensional representation of the dentition by performing a coarse matching by matching features as the plurality of labial and lingual surfaces are imaged, and

wherein the processor is further configured to generate a three-dimensional reconstruction of the dentition based on a point cloud alignment after the plurality of labial and lingual surfaces are all imaged.

6. The system of claim 1, wherein the processor is further configured to generate an occlusal backbone by matching selected frames of the contiguous scan of the occlusal surface that have an overlap based on an analysis of data.

7. The system of claim 6, wherein the processor is configured to detect the overlap ~~is~~ based on noise characteristics of the data.

8. The system of claim 6, wherein the occlusal backbone is a first occlusal backbone, and wherein the processor is further configured to generate a second occlusal backbone that is more accurate than the first occlusal backbone by linking other frames that are different from the selected frames to the first occlusal backbone.

9. The system of claim 8, wherein the processor is further configured to generate a third occlusal backbone by removing, from the second occlusal backbone, areas representing at least one selected from a group consisting of a tongue, a cheek, and a lip.

10. The system of claim 9, wherein the processor is configured to remove the areas representing the at least one selected from the group consisting of the tongue, the cheek, and the lip based on differences in surface normal, color, or rigidity properties.

11. The system of claim 1, further comprising:

a projector that projects interferometric fringes on an occlusal surface of at least a part of one arch of the dentition primarily along an anterior-posterior direction; and

an imaging sensor that is used to view the interferometric fringes,

wherein the processor is further configured to generate the contiguous scan of the occlusal surface based on the interferometric fringes sensed by the imaging sensor.

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

generate a contiguous scan of an occlusal surface of at least a part of one arch of the dentition; and

associate a scan of at least one additional surface to the contiguous scan of the occlusal surface.

13. The computer readable storage medium of claim 12, wherein the scan of the at least one additional surface comprises a plurality of scans of labial surfaces and a plurality of scans of lingual surfaces.

14. The computer readable storage medium of claim 13, wherein each scan of a labial or lingual surface includes a part of the occlusal surface, and wherein the code, when executed by the processor, causes the system to use the part of the occlusal surface that is included in each scan of the labial or lingual surface to associate the labial or lingual surface to the contiguous scan of the occlusal surface.

15. The computer readable storage medium of claim 13, wherein the occlusal surface is imaged prior to the plurality of labial and lingual surfaces, and wherein the code, when executed by the processor, causes the system to display in real-time a three-dimensional representation of the dentition as the plurality of labial and lingual surfaces are imaged.

16. The computer readable storage medium of claim 15, wherein the code, when executed by the processor, causes the system to display in real-time the three-dimensional representation of the dentition by performing a coarse matching by matching features as the plurality of labial and lingual surfaces are imaged, and

wherein the code, when executed by the processor, further causes the system to generate a three-dimensional reconstruction of the dentition based on a point cloud alignment after the plurality of labial and lingual surfaces are all imaged.

17. The computer readable storage medium of claim 12, wherein the code, when executed by the processor, further causes the system to generate an occlusal backbone by matching selected frames of the contiguous scan of the occlusal surface that have an overlap based on an analysis of data.

18. The computer readable storage medium of claim 17, wherein the code, when executed by the processor, further causes the system to detect the overlap based on noise characteristics of the data.

19. The computer readable storage medium of claim 17, wherein the occlusal backbone is a first occlusal backbone, and wherein the code, when executed by the processor, further causes the system to generate a second occlusal backbone that is more accurate than the first occlusal backbone by linking other frames that are different from the selected frames to the first occlusal backbone.

20. The computer readable storage medium of claim 19, wherein the code, when executed by the processor, further causes the system to generate a third occlusal backbone by removing, from the second occlusal backbone, areas representing at least one selected from a group consisting of a tongue, a cheek, and a lip.

21. The computer readable storage medium of claim 20, wherein the code, when executed by the processor, causes the system to remove the areas representing the at least one selected from the group consisting of the tongue, the cheek, and the lip based on differences in surface normal, color, or rigidity properties.

22. An imaging system, comprising:

a projector that projects interferometric fringes on an occlusal surface of at least a part of one arch of a dentition primarily along an anterior-posterior direction; and

an imaging sensor that is used to view the interferometric fringes.

23. The imaging system of claim 22, the imaging system configured to:

generate a contiguous scan of an occlusal surface, and

associate at least one additional surface to the contiguous scan of the occlusal surface.

24. The imaging system of claim 23, wherein the at least one additional surface comprises a plurality of labial surfaces and a plurality of lingual surfaces.

ABSTRACT

Provided are a system, method, and computer readable storage medium for generating an intra-oral scan of a dentition. A contiguous scan of an occlusal surface of at least a part of one arch of the dentition is generated. At least one additional surface is associated to the contiguous scan of the occlusal surface.

FIG. 1

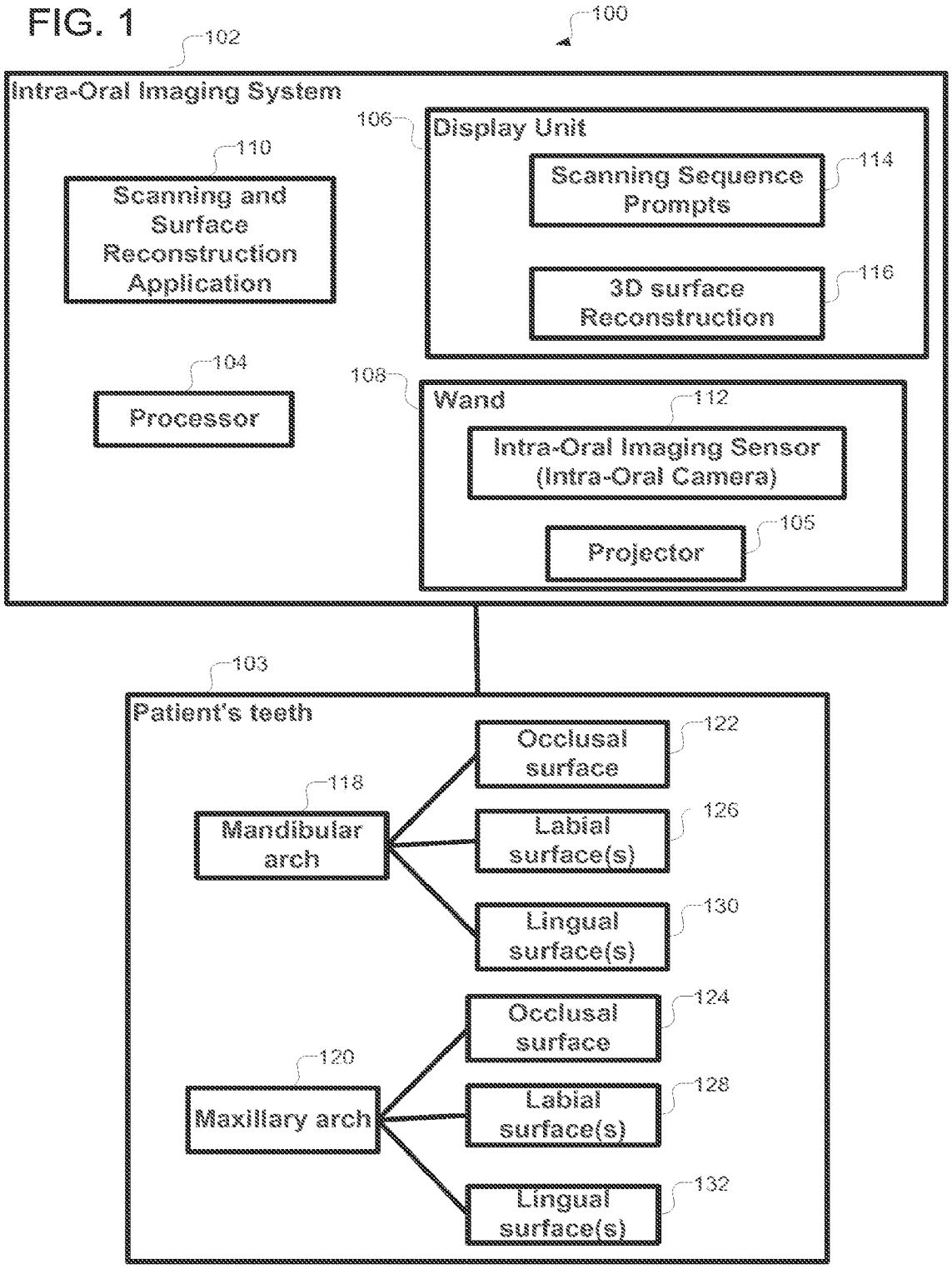

100
102
Intra-Oral Imaging System
106
Display Unit
110
Scanning and Surface Reconstruction Application
114
Scanning Sequence Prompts
116
3D surface Reconstruction
104
Processor
108
Wand
112
Intra-Oral Imaging Sensor (Intra-Oral Camera)
105
Projector
103
Patient's teeth
118
Mandibular arch
122
Occlusal surface
126
Labial surface(s)
130
Lingual surface(s)
120
Maxillary arch
124
Occlusal surface
128
Labial surface(s)
132
Lingual surface(s)

FIG. 2

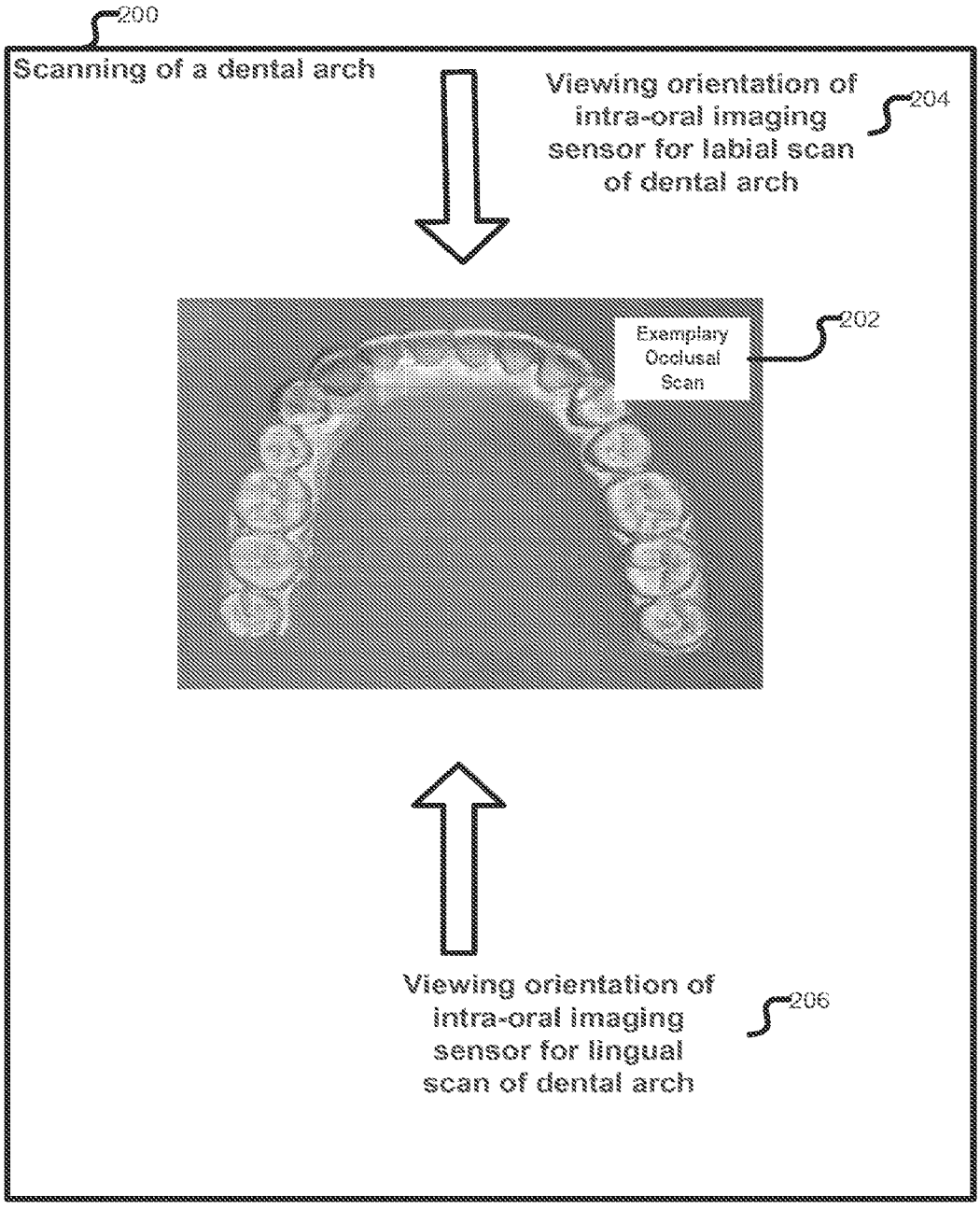

200
Scanning of a dental arch
Viewing orientation of intra-oral imaging sensor for labial scan of dental arch
204
Exemplary Occlusal Scan
202
Viewing orientation of intra-oral imaging sensor for lingual scan of dental arch
206

FIG. 3

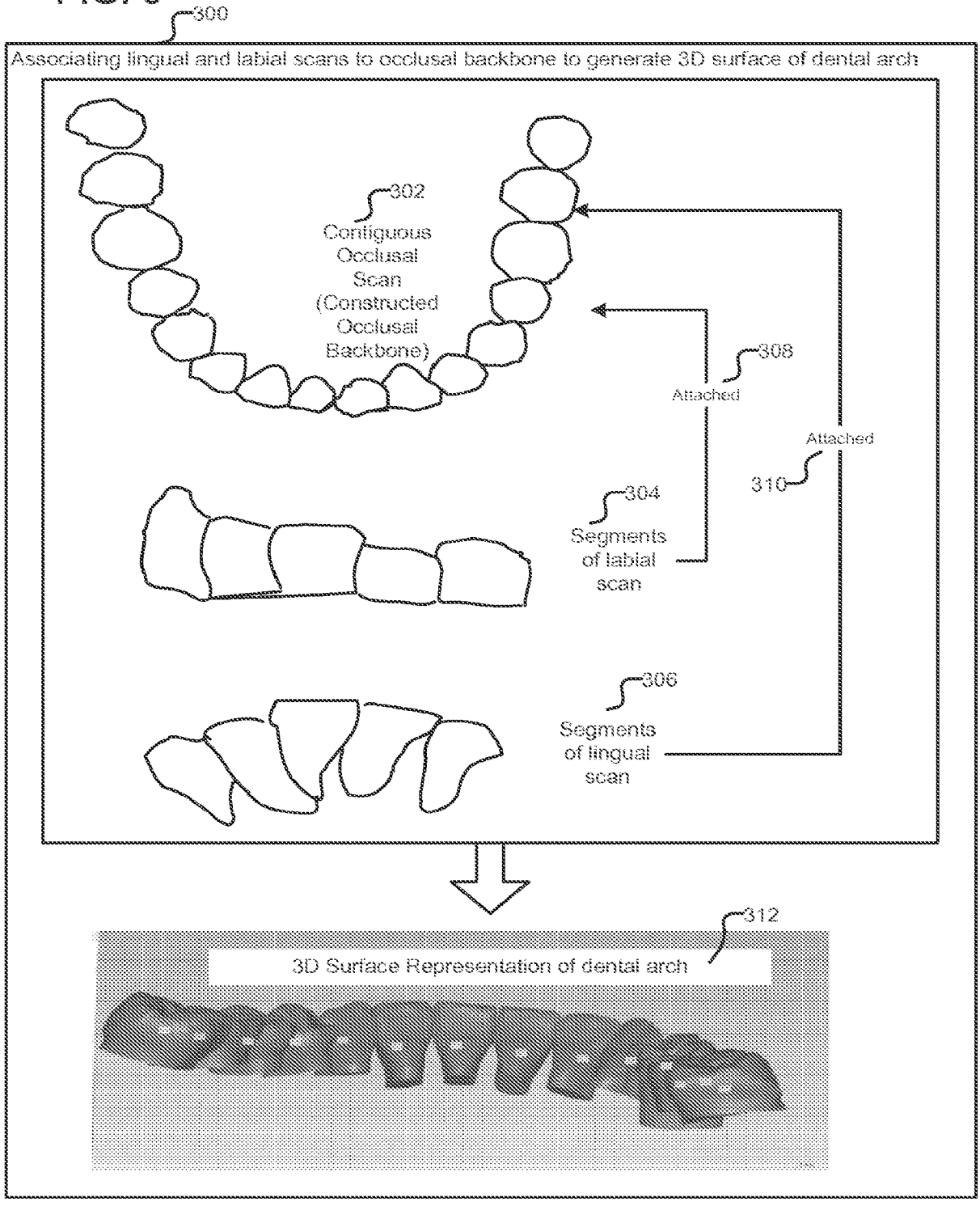

300
Associating lingual and labial scans to occlusal backbone to generate 3D surface of dental arch
302
Contiguous Occlusal Scan (Constructed Occlusal Backbone)
308
Attached
Attached
310
304
Segments of labial scan
306
Segments of lingual scan
312
3D Surface Representation of dental arch

FIG. 4

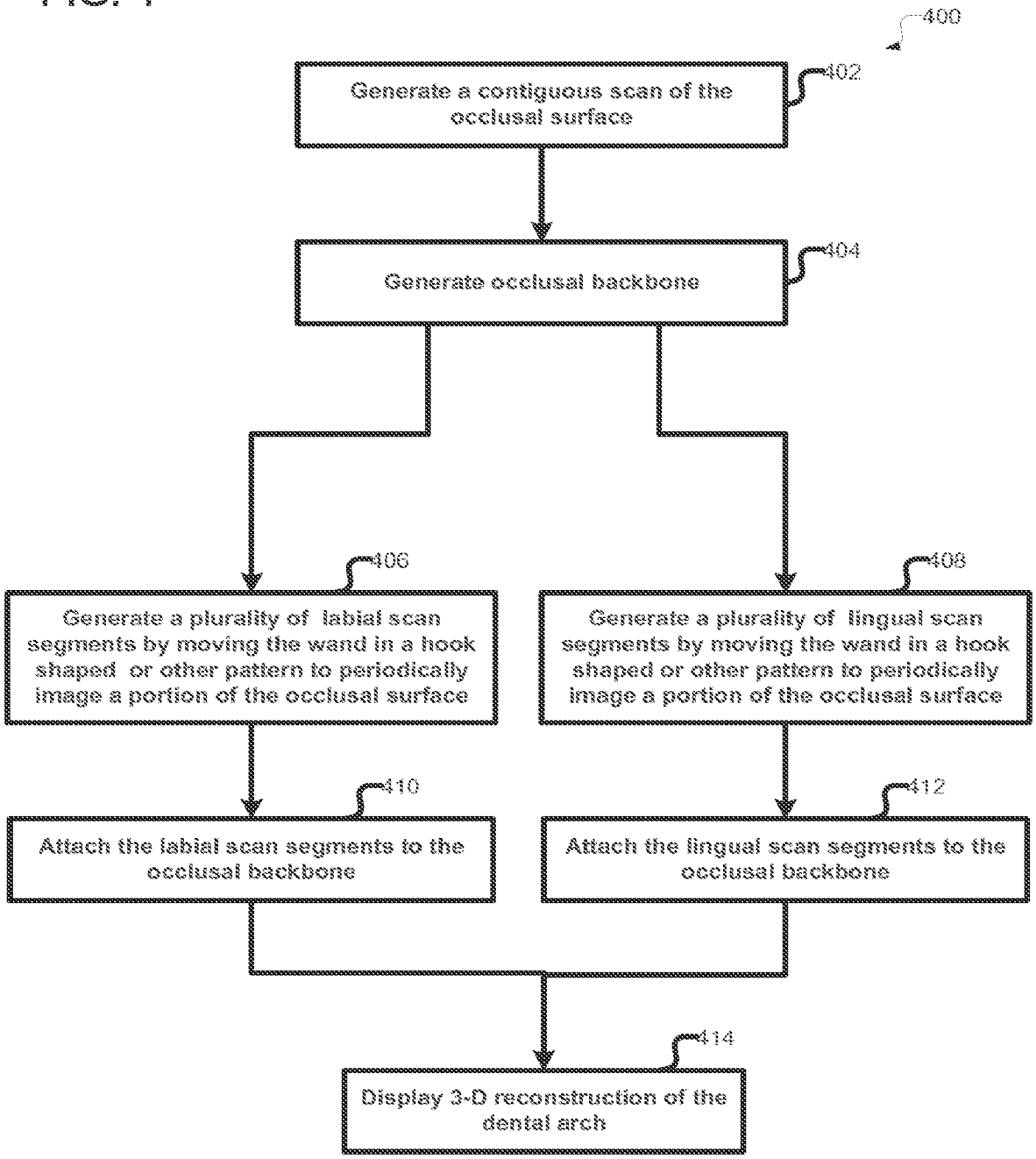

400
Generate a contiguous scan of the occlusal surface
402
Generate occlusal backbone
404
Generate a plurality of labial scan segments by moving the wand in a hook shaped or other pattern to periodically image a portion of the occlusal surface
406
Generate a plurality of lingual scan segments by moving the wand in a hook shaped or other pattern to periodically image a portion of the occlusal surface
408
Attach the labial scan segments to the occlusal backbone
410
Attach the lingual scan segments to the occlusal backbone
412
Display 3-D reconstruction of the dental arch
414

FIG. 5

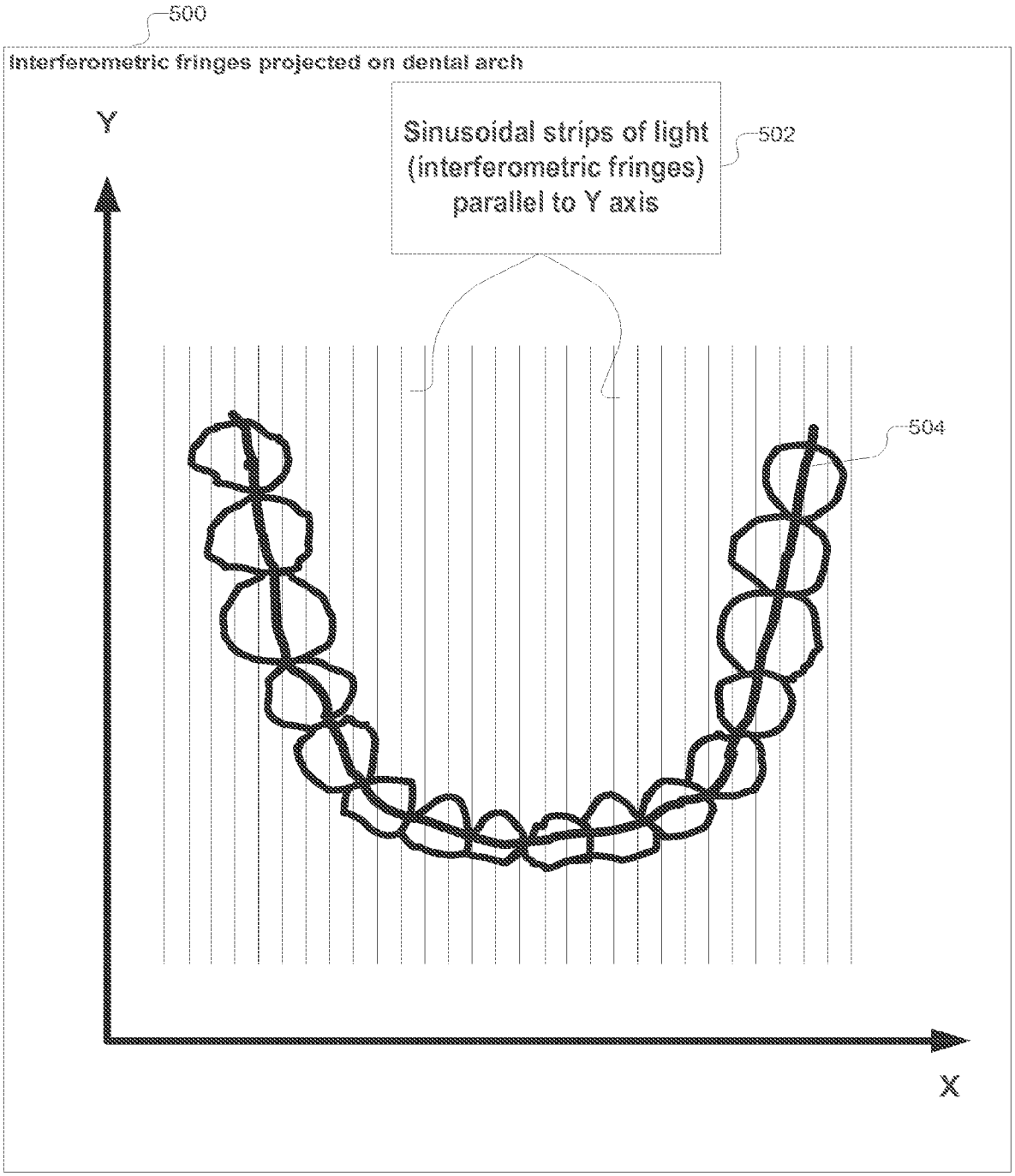

500
Interferometric fringes projected on dental arch
Y
Sinusoidal strips of light (interferometric fringes) parallel to Y axis
502
504
X

FIG. 6

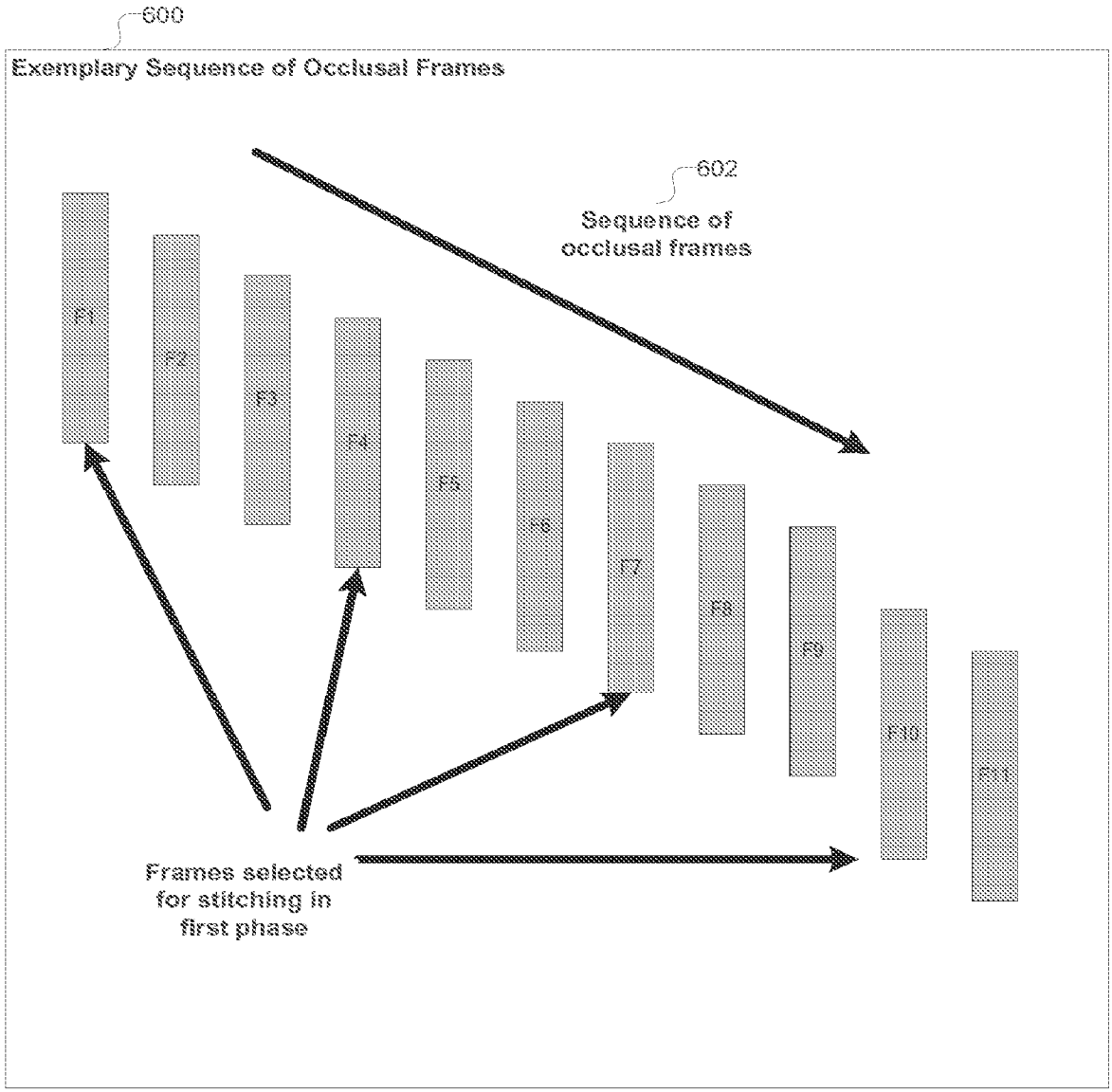

600
Exemplary Sequence of Occlusal Frames
602
Sequence of occlusal frames
F1
F2
F3
F4
F5
F6
F7
F8
F9
F10
F11
Frames selected for stitching in first phase

FIG. 7

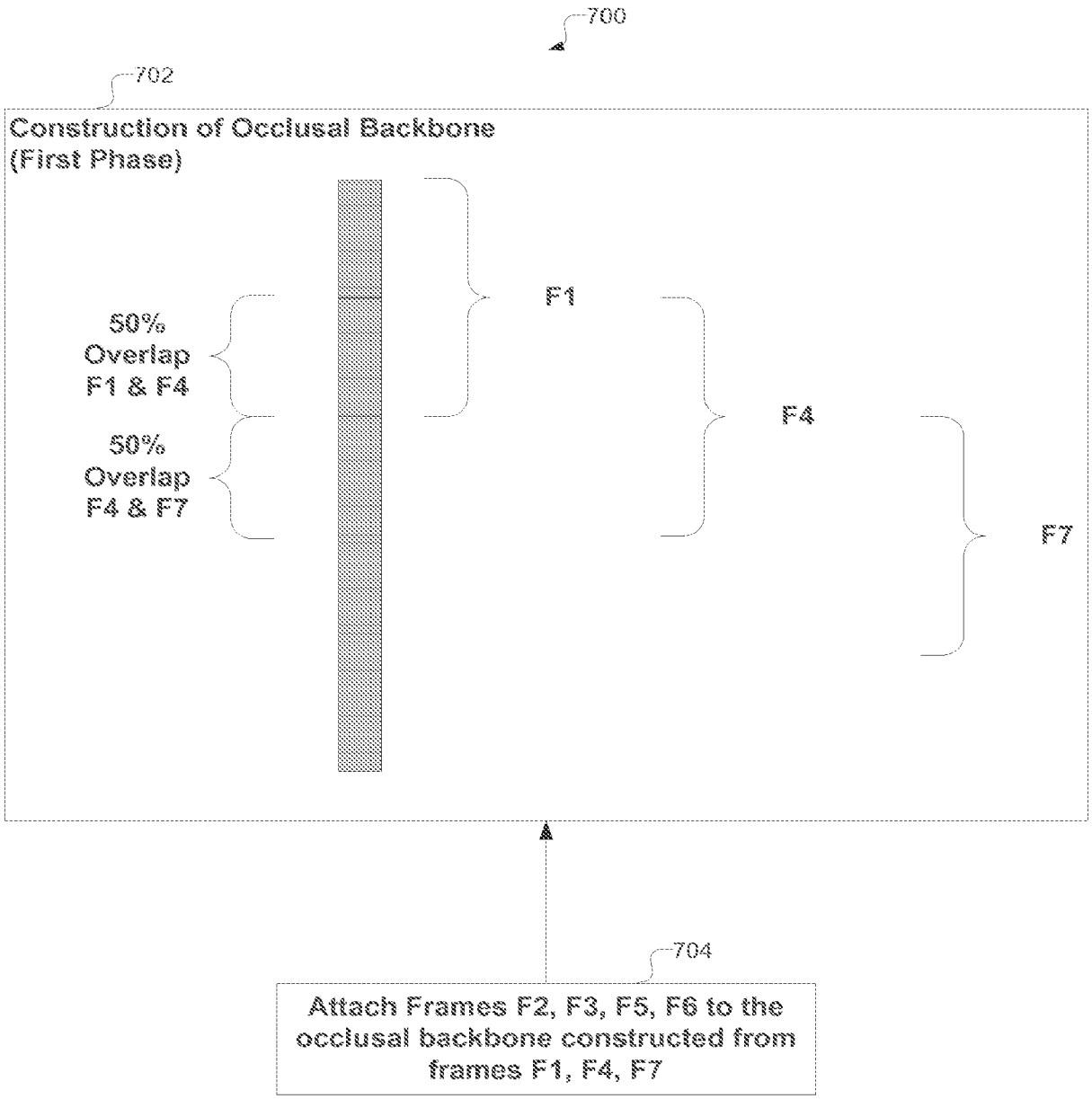

700
702
Construction of Occlusal Backbone
(First Phase)
F1
50%
Overlap
F1 & F4
F4
50%
Overlap
F4 & F7
F7
704
Attach Frames F2, F3, F5, F6 to the occlusal backbone constructed from frames F1, F4, F7

FIG. 8

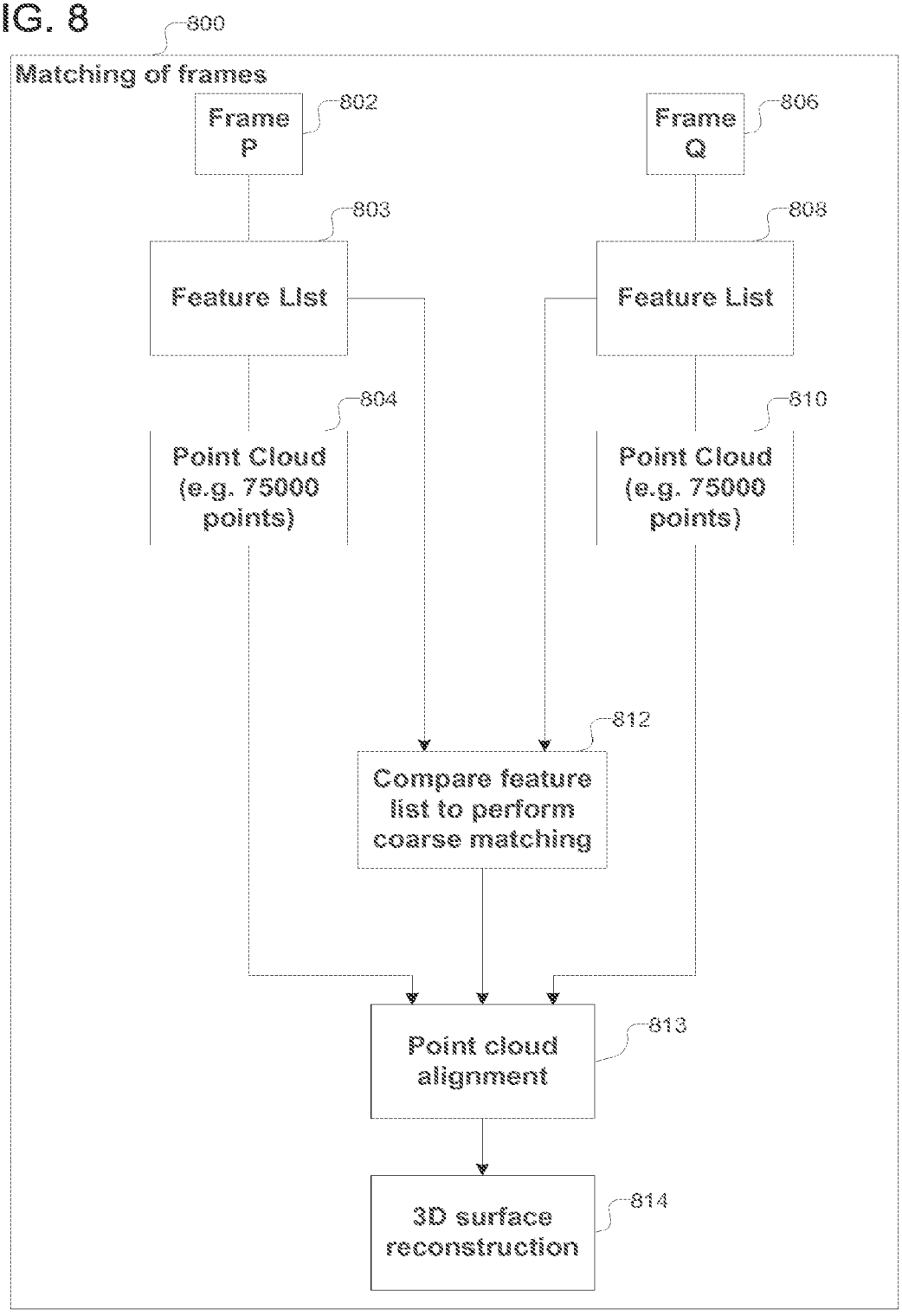

800
Matching of frames
Frame P
802
Frame Q
806
803
Feature List
808
Feature List
804
Point Cloud (e.g. 75000 points)
810
Point Cloud (e.g. 75000 points)
812
Compare feature list to perform coarse matching
Point cloud alignment
813
3D surface reconstruction
814

FIG. 9

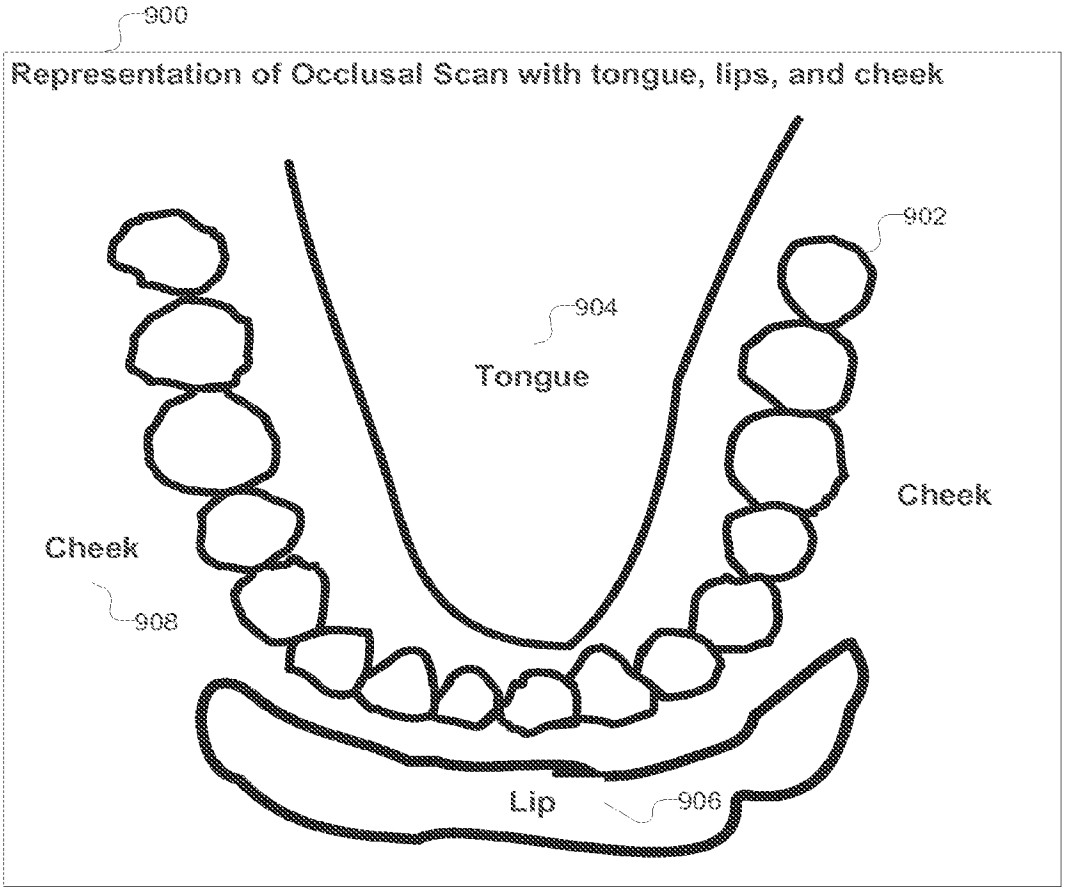

900
Representation of Occlusal Scan with tongue, lips, and cheek
902
904
Tongue
Cheek
Cheek
908
Lip
906

FIG. 10

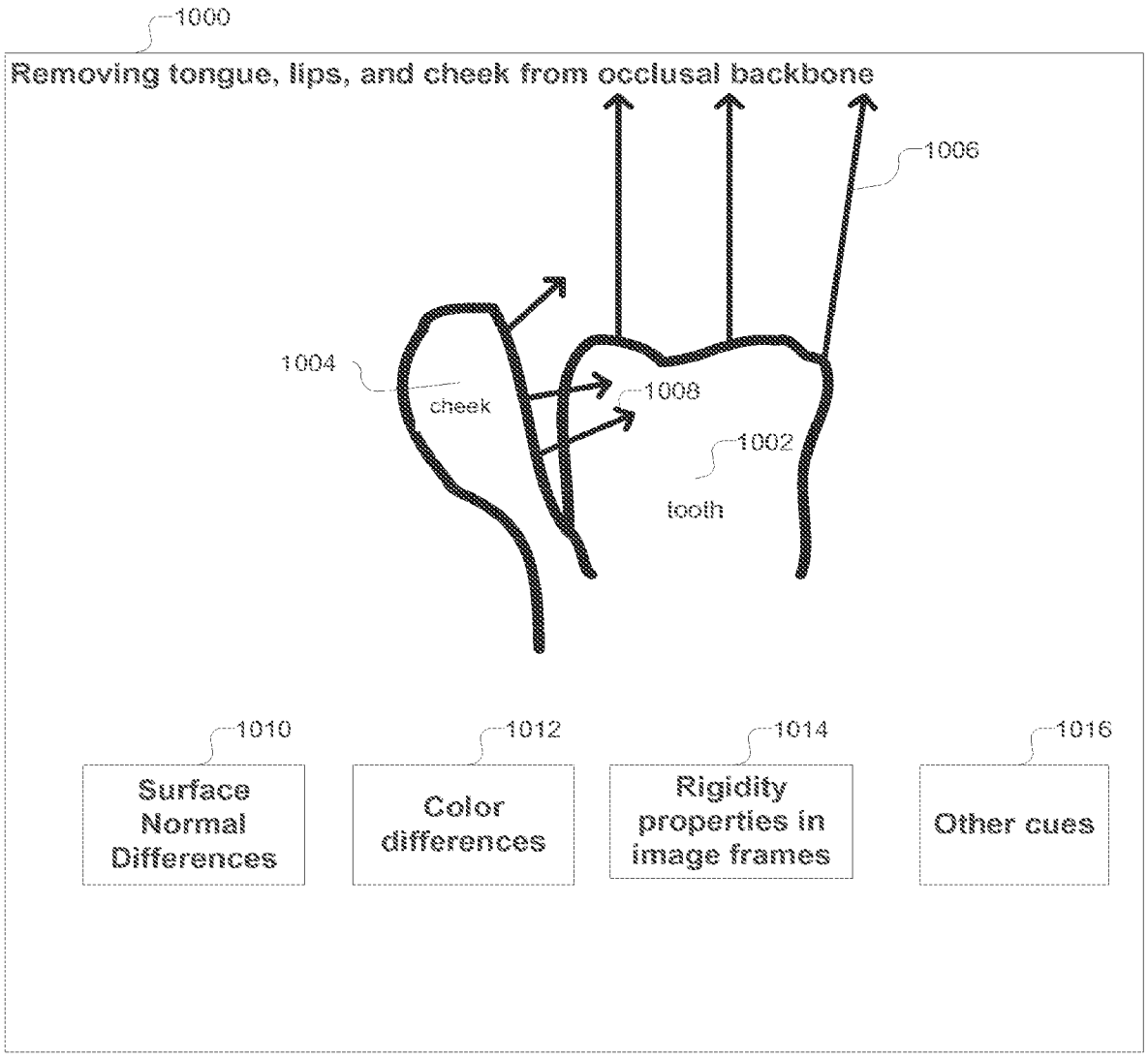

1000
Removing tongue, lips, and cheek from occlusal backbone
1006
1004
cheek
1008
1002
tooth
1010
Surface Normal Differences
1012
Color differences
1014
Rigidity properties in image frames
1016
Other cues

FIG. 11

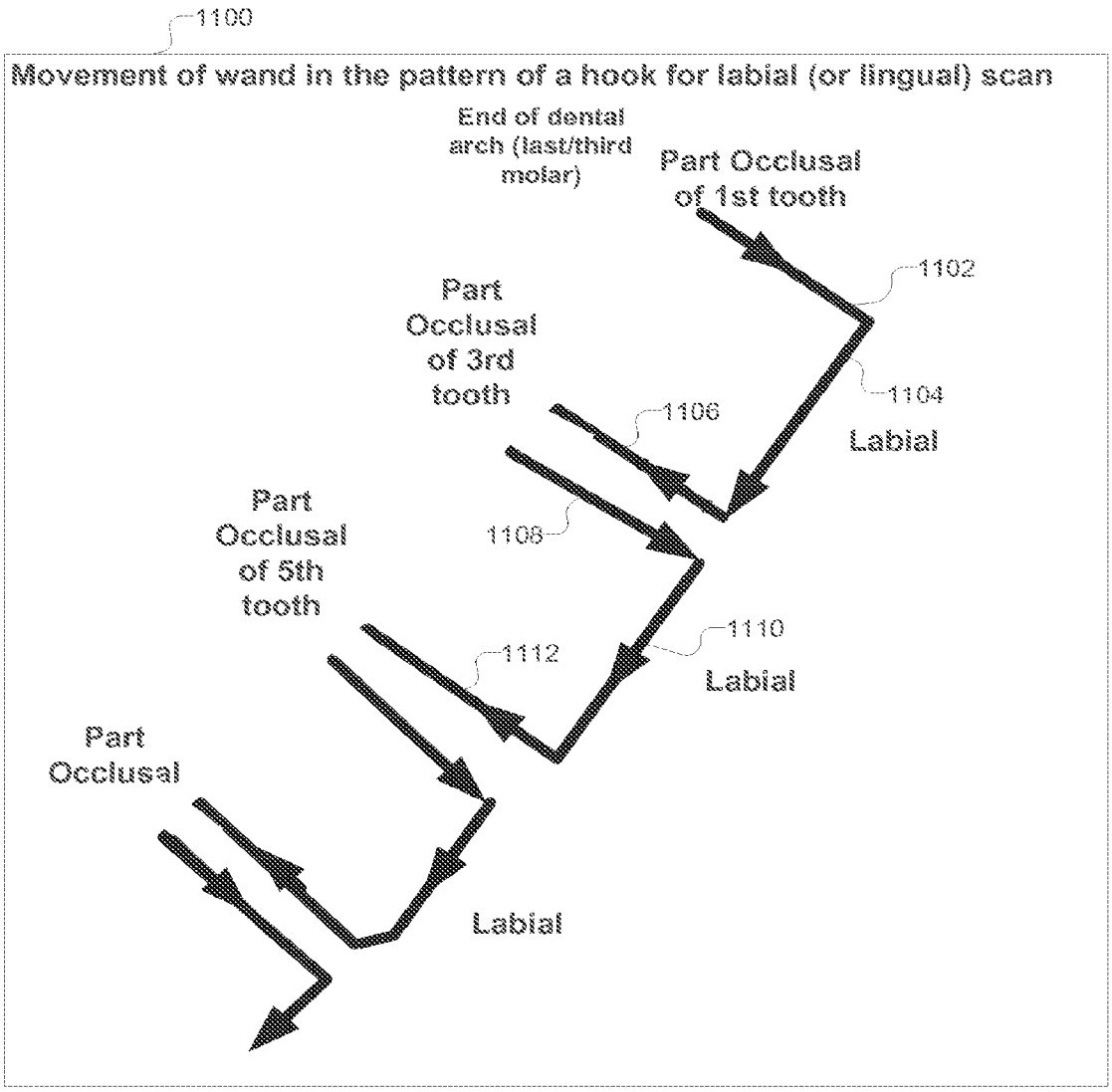

1100
Movement of wand in the pattern of a hook for labial (or lingual) scan
End of dental arch (last/third molar)
Part Occlusal of 1st tooth
1102
Part Occlusal of 3rd tooth
1104
Labial
1106
1108
Part Occlusal of 5th tooth
1110
Labial
1112
Part Occlusal
Labial

FIG. 12

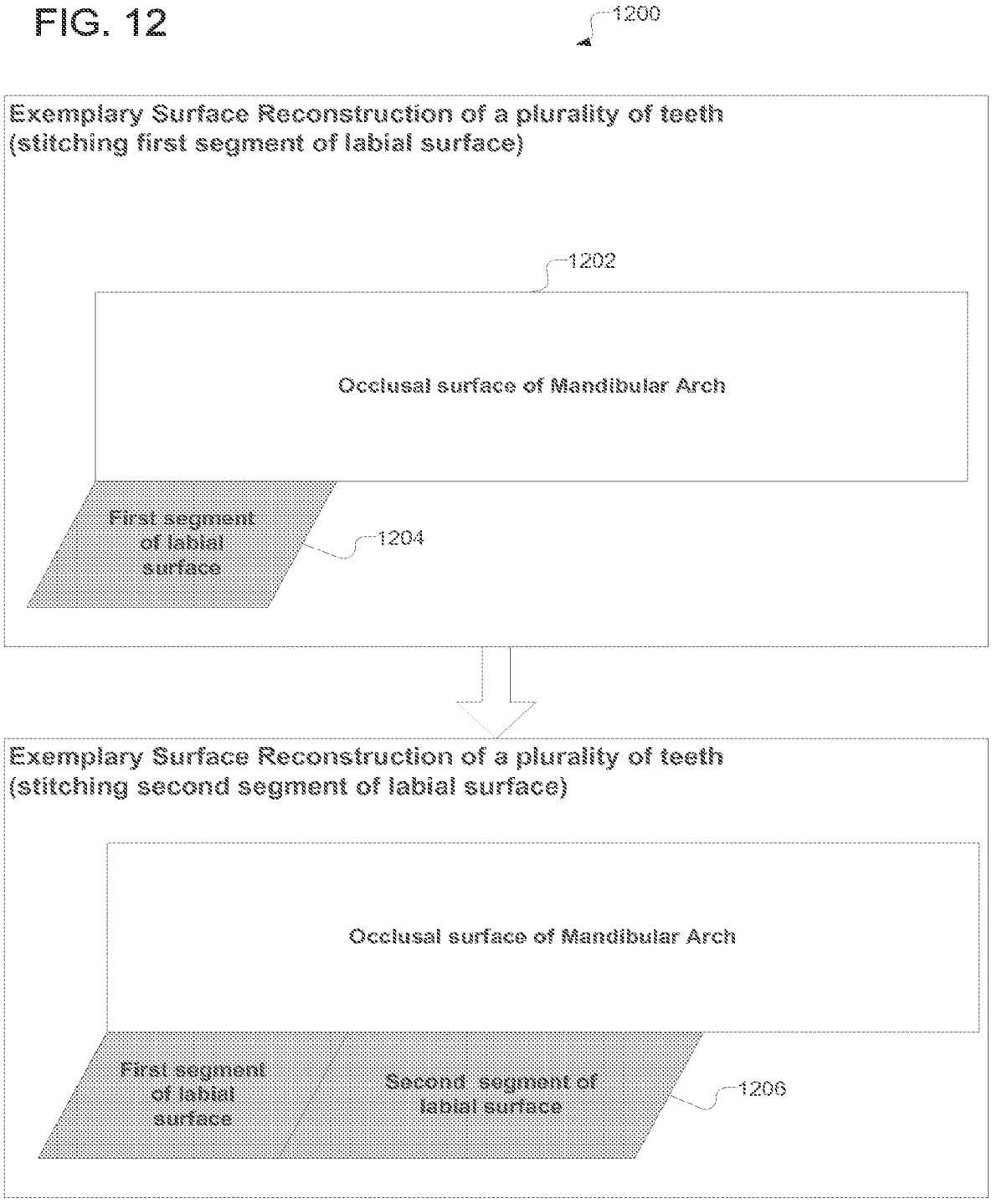

1200
Exemplary Surface Reconstruction of a plurality of teeth (stitching first segment of labial surface)
1202
Occlusal surface of Mandibular Arch
First segment of labial surface
1204
Exemplary Surface Reconstruction of a plurality of teeth (stitching second segment of labial surface)
Occlusal surface of Mandibular Arch
First segment of labial surface
Second segment of labial surface
1206

FIG. 13

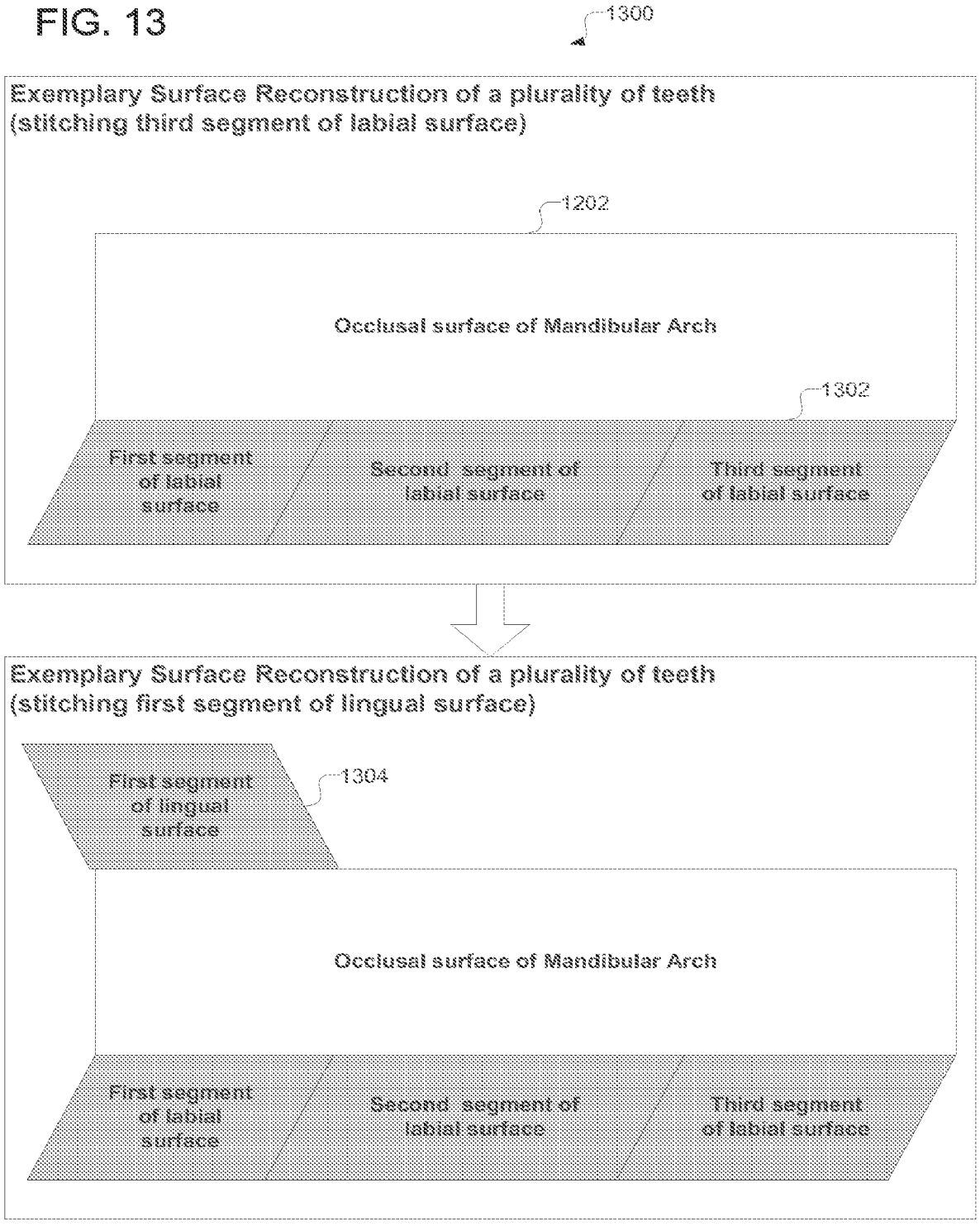

1300
Exemplary Surface Reconstruction of a plurality of teeth (stitching third segment of labial surface)
1202
Occlusal surface of Mandibular Arch
1302
First segment of labial surface
Second segment of labial surface
Third segment of labial surface
Exemplary Surface Reconstruction of a plurality of teeth (stitching first segment of lingual surface)
First segment of lingual surface
1304
Occlusal surface of Mandibular Arch
First segment of labial surface
Second segment of labial surface
Third segment of labial surface

FIG. 14

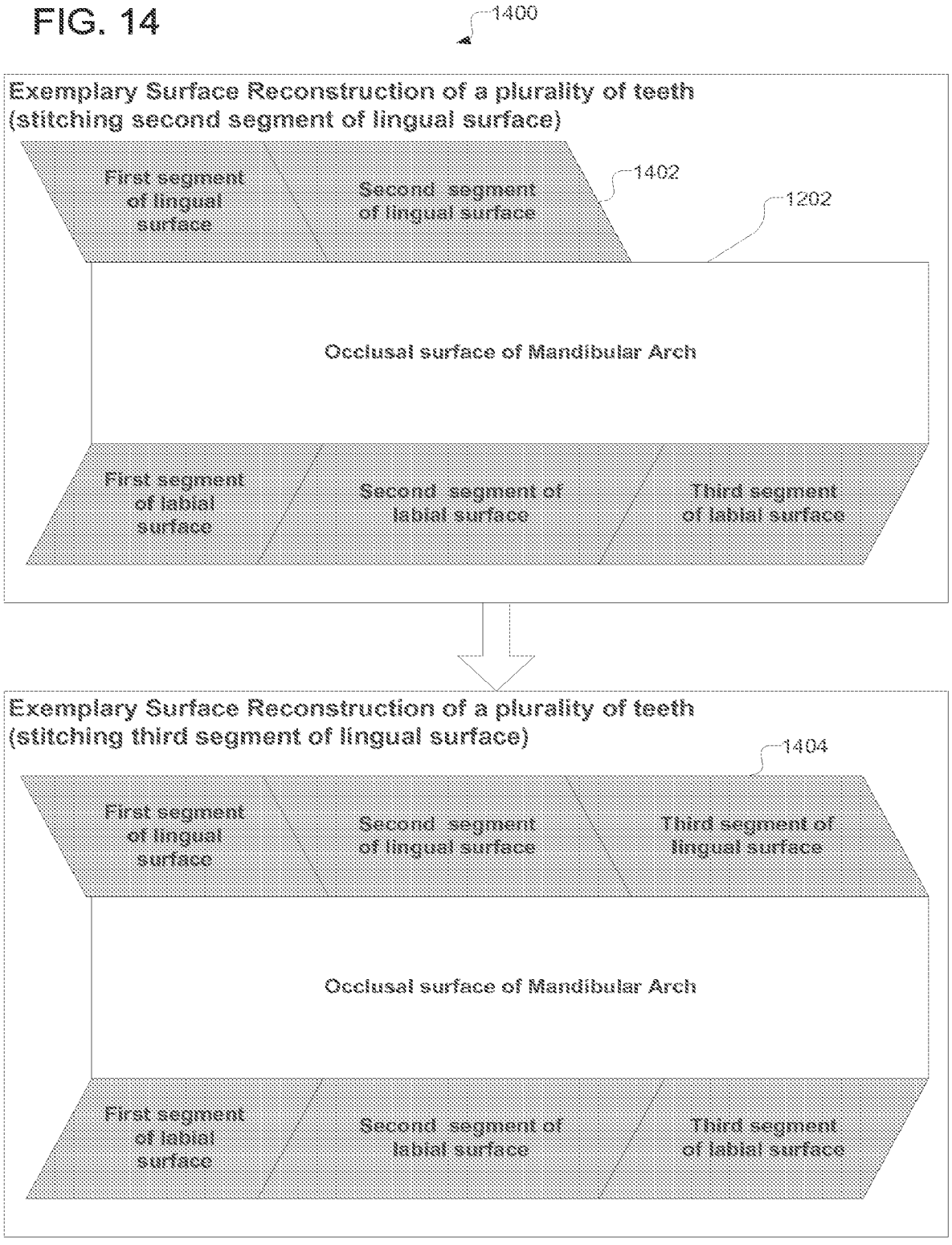

1400
Exemplary Surface Reconstruction of a plurality of teeth (stitching second segment of lingual surface)
First segment of lingual surface
Second segment of lingual surface
1402
1202
Occlusal surface of Mandibular Arch
First segment of labial surface
Second segment of labial surface
Third segment of labial surface
Exemplary Surface Reconstruction of a plurality of teeth (stitching third segment of lingual surface)
1404
First segment of lingual surface
Second segment of lingual surface
Third segment of lingual surface
Occlusal surface of Mandibular Arch
First segment of labial surface
Second segment of labial surface
Third segment of labial surface

FIG. 15

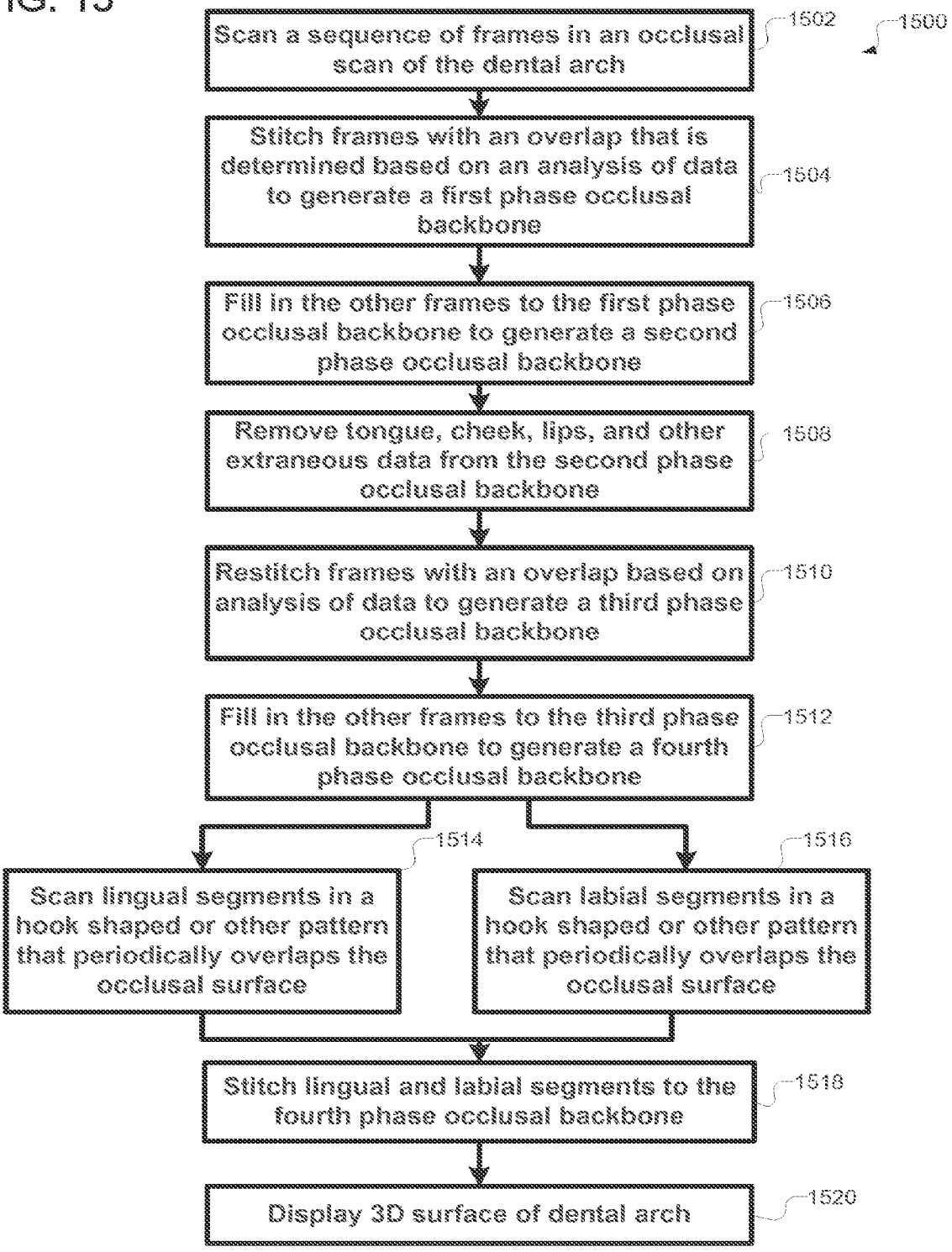

Scan a sequence of frames in an occlusal scan of the dental arch
1502
1500
Stitch frames with an overlap that is determined based on an analysis of data to generate a first phase occlusal backbone
1504
Fill in the other frames to the first phase occlusal backbone to generate a second phase occlusal backbone
1506
Remove tongue, cheek, lips, and other extraneous data from the second phase occlusal backbone
1508
Restitch frames with an overlap based on analysis of data to generate a third phase occlusal backbone
1510
Fill in the other frames to the third phase occlusal backbone to generate a fourth phase occlusal backbone
1512
Scan lingual segments in a hook shaped or other pattern that periodically overlaps the occlusal surface
1514
Scan labial segments in a hook shaped or other pattern that periodically overlaps the occlusal surface
1516
Stitch lingual and labial segments to the fourth phase occlusal backbone
1518
Display 3D surface of dental arch
1520

FIG. 16

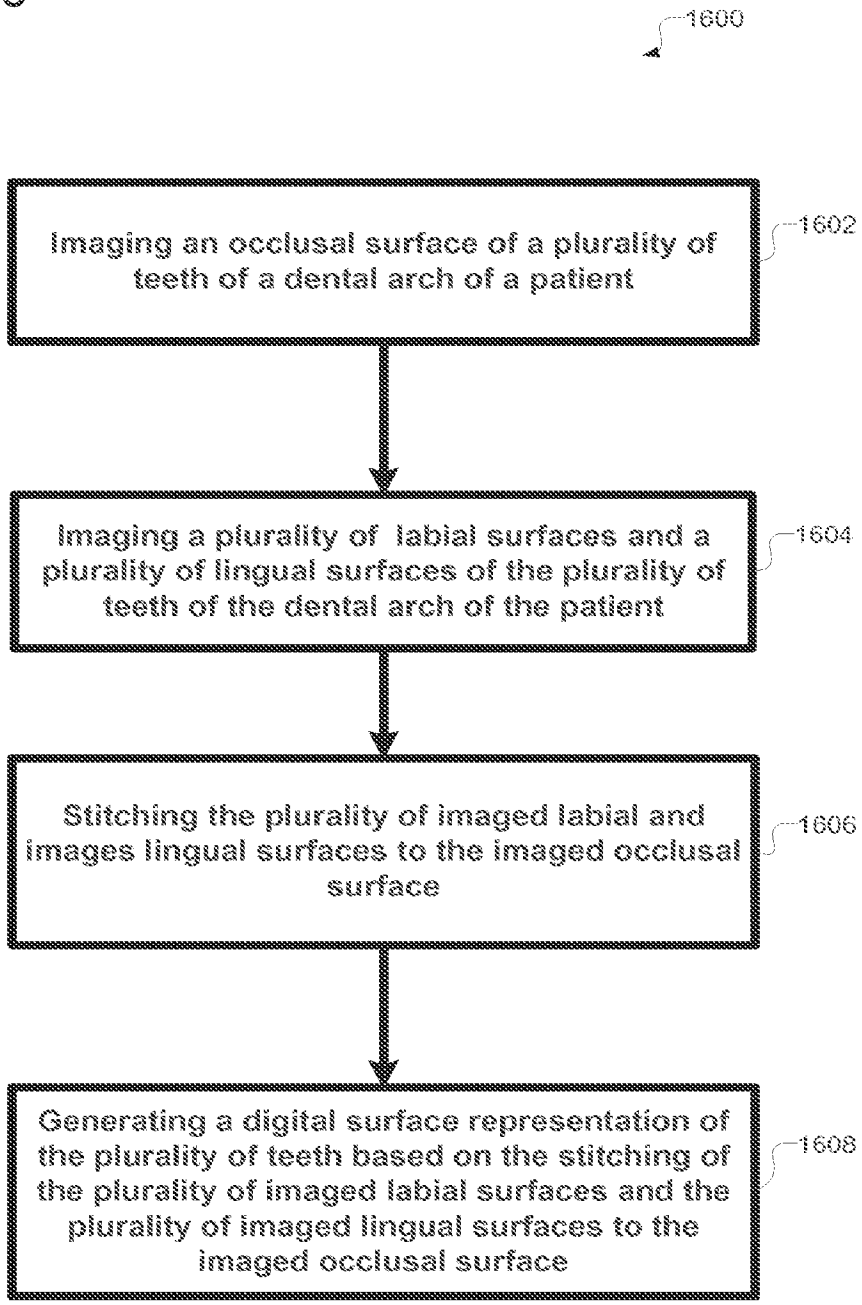

1600
Imaging an occlusal surface of a plurality of teeth of a dental arch of a patient
1602
Imaging a plurality of labial surfaces and a plurality of lingual surfaces of the plurality of teeth of the dental arch of the patient
1604
Stitching the plurality of imaged labial and images lingual surfaces to the imaged occlusal surface
1606
Generating a digital surface representation of the plurality of teeth based on the stitching of the plurality of imaged labial surfaces and the plurality of imaged lingual surfaces to the imaged occlusal surface
1608

FIG. 17

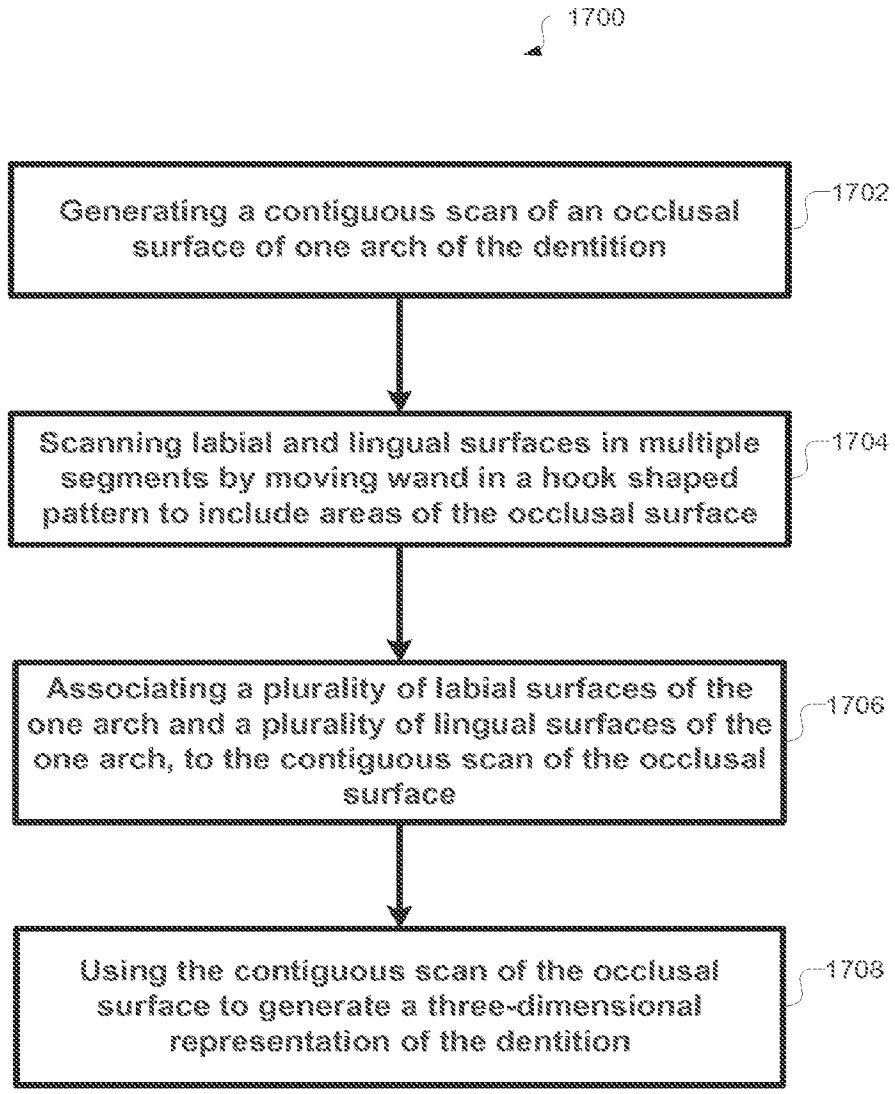

1700
Generating a contiguous scan of an occlusal surface of one arch of the dentition
1702
Scanning labial and lingual surfaces in multiple segments by moving wand in a hook shaped pattern to include areas of the occlusal surface
1704
Associating a plurality of labial surfaces of the one arch and a plurality of lingual surfaces of the one arch, to the contiguous scan of the occlusal surface
1706
Using the contiguous scan of the occlusal surface to generate a three-dimensional representation of the dentition
1708

FIG. 18

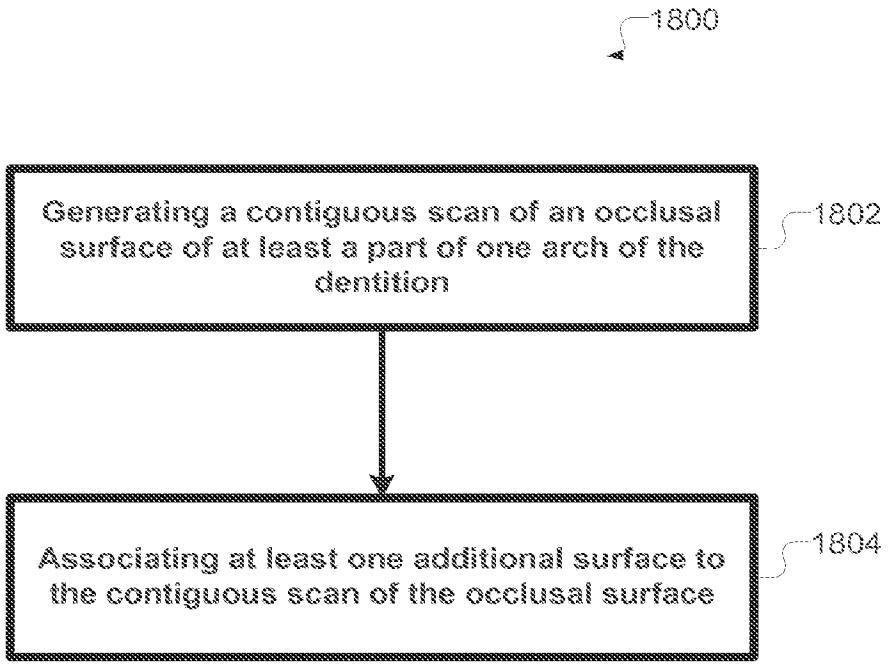

1800
Generating a contiguous scan of an occlusal surface of at least a part of one arch of the dentition
1802
Associating at least one additional surface to the contiguous scan of the occlusal surface
1804

FIG. 19

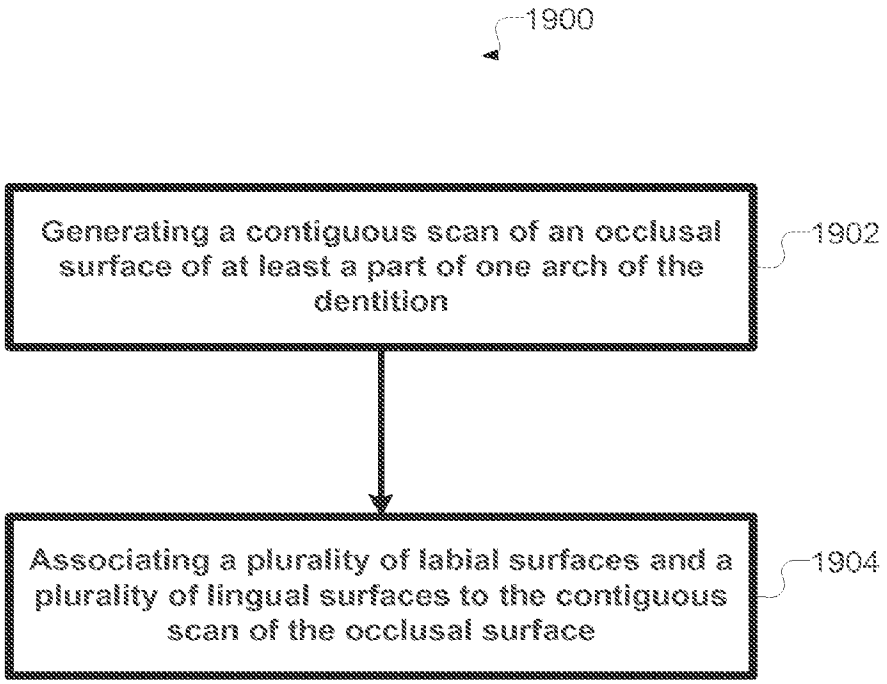
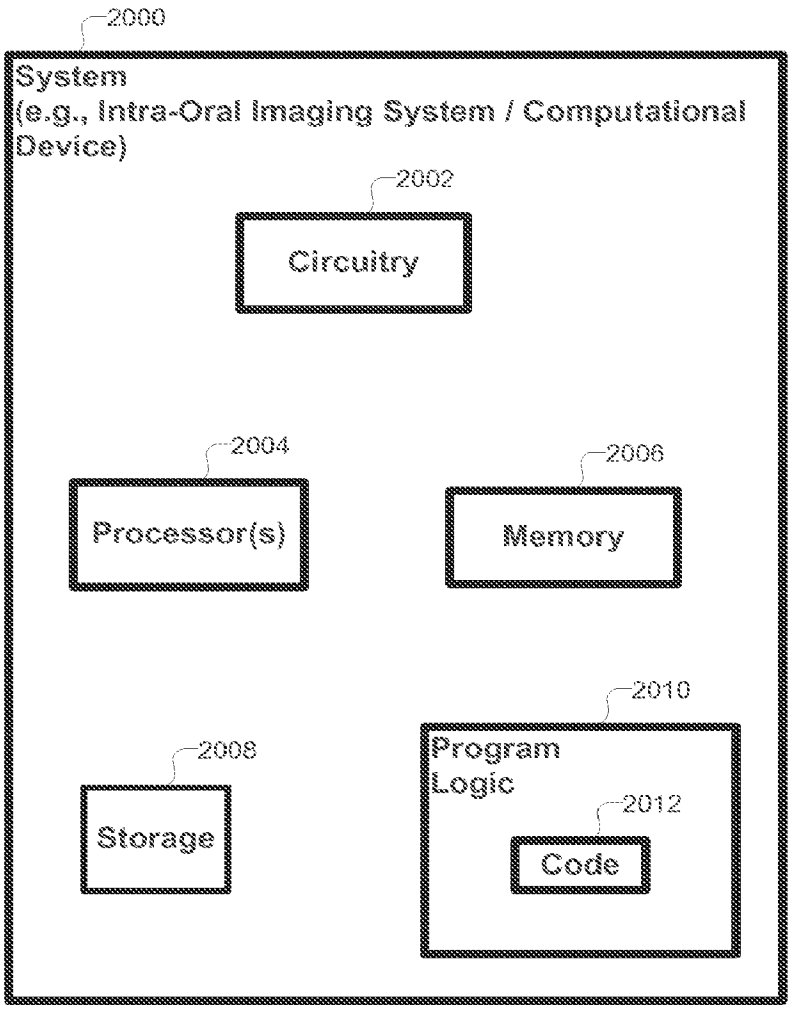

1900
Generating a contiguous scan of an occlusal surface of at least a part of one arch of the dentition
1902
Associating a plurality of labial surfaces and a plurality of lingual surfaces to the contiguous scan of the occlusal surface
1904

FIG. 20


2000
System
(e.g., Intra-Oral Imaging System / Computational Device)
2002
Circuitry
2004
Processor(s)
2006
Memory
2008
Storage
2010
Program Logic
2012
Code

DOCKET NUMBER: 100406
FIRM NUMBER: 0020.0016

DECLARATION (37 C.F.R. 1.63) FOR UTILITY PATENT APPLICATION USING AN APPLICATION DATA SHEET (37 C.F.R. 1.76) AND ASSIGNMENT

Title of Invention:
SCANNING SEQUENCE FOR AN INTRA-ORAL IMAGING SYSTEM

As a below named inventor, I hereby declare that:

This declaration is directed to the attached application, or (if following box is checked):

[X] United States application or PCT international application number

14/209,643 filed on March 13, 2014.

The above-identified application was made or authorized to be made by me.

I believe that I am the original inventor or an original joint inventor of a claimed invention in the application.

I have reviewed and understand the contents of the application, including the claims.

I am aware of the duty to disclose to the United States Patent and Trademark Office all information known to me to be material to patentability as defined in 37 CFR Section 1.56.

Whereas, the undersigned inventor(s) has/have made certain inventions, improvements, and discoveries (herein referred to as the "Invention") disclosed in the above-identified patent application and further identified by the docket number provided above in the header of this document;

Now therefore, in consideration good and valuable consideration, the receipt and sufficiency whereof are hereby acknowledged, we, the undersigned inventor(s) hereby convey, transfer and assign to ORMCO CORPORATION (hereinafter referred to as "Assignee"), a corporation of Delaware, having a principal place of business at 1717 W. Collins Avenue, Orange, California, its successors, legal representatives and assigns, the entire right, title and interest throughout the world in the above-mentioned invention or improvements, in the above-mentioned application for United States Letters Patent, and any and all other applications for United States Letters Patent and applications in any other countries which may be filed on said invention or improvements, and in any and all Letters Patent of the United States or of any other country which may be obtained on any of said applications, and in any reissue, reexam or extension thereof.

We hereby authorize and request the Commissioner of Patents to issue said Letters Patent to said Assignee.

We hereby authorize and request the attorneys of record in said application to insert in this Assignment the date and serial number of said application when officially known.

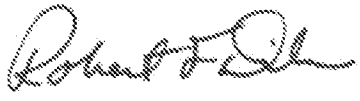
We warrant ourselves to be the owners of the interest herein assigned and to have the right to make this

assignment; and further warrant that there are no outstanding prior assignments, licenses, or other rights in the interest herein assigned.

For said consideration we hereby agree, upon the request and at the expense of said Assignee, its successors, legal representatives and assigns, to execute any and all divisional, continuation, and C-I-P applications for said invention or improvements, and any necessary oath or supplemental oath or affidavit relating thereto, and any application for the reissue, reexam or extension of any Letters Patent that may be granted upon said application that said Assignee, its successors, legal representatives and assigns may deem necessary or expedient. For said consideration we further agree, upon the request of said Assignee, its successors, legal representatives and assigns, in the event of said application or any division, continuation, or C-I-P thereof, or Letters Patent issued thereon, or any reexam, reissue or application for the reissue thereof becoming involved in interference, to cooperate to the best of our ability with said Assignee, its successors, legal representatives and assigns in the matters of preparing and executing the preliminary statement and giving and producing evidence in support thereof. We further agree to perform, upon such request, any and all affirmative acts to obtain Letters Patent, and vest all rights therein hereby conveyed in said Assignee, its successors, legal representatives and assigns whereby said Letters Patent will be held and enjoyed by said Assignee, its successors, legal representatives and assigns to the end of the term for which said Letters Patent may be granted as fully and entirely as the same would have been held and enjoyed by us if this assignment and sale had not been made, and for said considerations we hereby also assign to said Assignee, its successors, legal representatives and assigns the entire rights, title and interest in said invention or improvements for any and all foreign countries and the right of priority for patent and utility model applications in all countries arising under any applicable international convention for the protection of industrial property and/or any internal priority legislation of such countries, and we further agree upon the request of said Assignee, its successors, legal representatives and assigns to execute any and all documents that shall be required to be executed in connection with any and all applications for foreign Letters Patent therefor, including the prosecution thereof, and to execute any and all documents necessary to invest title in said foreign applications and patents in said Assignee.

I hereby acknowledge that any willful false statement made in this declaration is punishable under 18 U.S.C. 1001 by fine or imprisonment of not more than five (5) years, or both.

(1) Legal Name of Inventor: Robert F. DILLON

SIGNATURE:  DATE: 2/18/15

(2) Legal Name of Inventor: Craig A. ANDREIKO

SIGNATURE: DATE:

(3) Legal Name of Inventor: Andrew F. VESPER

SIGNATURE: Andrew F Vesper DATE: February 20, 2015

(4) Legal Name of Inventor: Neil H.K. JUDELL

SIGNATURE: [signature] DATE: 2/20/2015

(5) Legal Name of Inventor: Timothy L. FILLION

SIGNATURE: [signature] DATE: 2/24/2015

PTO/**AIA/02** (07-13)
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U.S. Patent and Trademark Office; U.S. DEPARTMENT OF COMMERCE
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SUBSTITUTE STATEMENT IN LIEU OF AN OATH OR DECLARATION FOR UTILITY OR DESIGN PATENT APPLICATION (35 U.S.C. 115(d) AND 37 CFR 1.64)

Title of Invention	SCANNING SEQUENCE FOR AN INTRA-ORAL IMAGING SYSTEM

This statement is directed to:

☐ The attached application,

OR

☒ United States application or PCT international application number 14/209,648 filed on March 13, 2014.

LEGAL NAME of inventor to whom this substitute statement applies:

(*E.g.*, Given Name (first and middle (if any)) and Family Name or Surname)

Craig A. ANDREIKO

Residence (except for a deceased or legally incapacitated inventor):

City Deceased	State	Country

Mailing Address (except for a deceased or legally incapacitated inventor):

Deceased

City Deceased	State	Zip	Country

I believe the above-named inventor or joint inventor to be the original inventor or an original joint inventor of a claimed invention in the application.

The above-identified application was made or authorized to be made by me.

I hereby acknowledge that any willful false statement made in this statement is punishable under 18 U.S.C. 1001 by fine or imprisonment of not more than five (5) years, or both.

Relationship to the inventor to whom this substitute statement applies:

- ☐ Legal Representative (for deceased or legally incapacitated inventor only),
- ☐ Assignee,
- ☒ Person to whom the inventor is under an obligation to assign,
- ☐ Person who otherwise shows a sufficient proprietary interest in the matter (petition under 37 CFR 1.46 is required), or
- ☐ Joint Inventor.

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SUBSTITUTE STATEMENT

Circumstances permitting execution of this substitute statement:

- [x] Inventor is deceased.
- [ ] Inventor is under legal incapacity.
- [ ] Inventor cannot be found or reached after diligent effort, or
- [ ] Inventor has refused to execute the oath or declaration under 37 CFR 1.63.

If there are joint inventors, please check the appropriate box below:

- [x] An application data sheet under 37 CFR 1.76 (PTO/AIA/14 or equivalent) naming the entire inventive entity has been or is currently submitted.

OR

- [ ] An application data sheet under 37 CFR 1.76 (PTO/AIA/14 or equivalent) has not been submitted. Thus, a Substitute Statement Supplemental Sheet (PTO/AIA/11 or equivalent) naming the entire inventive entity and providing inventor information is attached. See 37 CFR 1.64(b).

WARNING:

Petitioner/applicant is cautioned to avoid submitting personal information in documents filed in a patent application that may contribute to identity theft. Personal information such as social security numbers, bank account numbers, or credit card numbers (other than a check or credit card authorization form PTO-2038 submitted for payment purposes) is never required by the USPTO to support a petition or an application. If this type of personal information is included in documents submitted to the USPTO, petitioners/applicants should consider redacting such personal information from the documents before submitting them to the USPTO. Petitioner/applicant is advised that the record of a patent application is available to the public after publication of the application (unless a non-publication request in compliance with 37 CFR 1.213(a) is made in the application) or issuance of a patent. Furthermore, the record from an abandoned application may also be available to the public if the application is referenced in a published application or an issued patent (see 37 CFR 1.14). Checks and credit card authorization forms PTO-2038 submitted for payment purposes are not retained in the application file and therefore are not publicly available.

PERSON EXECUTING THIS SUBSTITUTE STATEMENT:

Name: Rajiv Yadav | Date (Optional): 5/30/14

Signature: [signature]

APPLICANT NAME AND TITLE OF PERSON EXECUTING THIS SUBSTITUTE STATEMENT:

If the applicant is a juristic entity, list the applicant name and the title of the signer:

Applicant Name: ORMCO CORPORATION

Title of Person Executing This Substitute Statement: Chief IP Counsel

The signer, whose title is supplied above, is authorized to act on behalf of the applicant.

Residence of the signer (unless provided in an application data sheet, PTO/AIA/14 or equivalent):

City: South Pasadena | State: CA | Country: USA

Mailing Address of the signer (unless provided in an application data sheet, PTO/AIA/14 or equivalent)

1717 W. Collins Avenue

City: Orange | State: CA | Zip: 92867 | Country: US

Note: Use an additional PTO/AIA/02 form for each inventor who is deceased, legally incapacitated, cannot be found or reached after diligent effort, or has refused to execute the oath or declaration under 37 CFR 1.63.