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Declarations under Rule 4.17:

- as to applicant's entitlement to apply for and be granted a patent (Rule 4.17(ii))
- as to the applicant's entitlement to claim the priority of the earlier application (Rule 4.17(iii))

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[Continued on next page]

(54) Title: ORTHODONTIC DIGITAL SETUPS

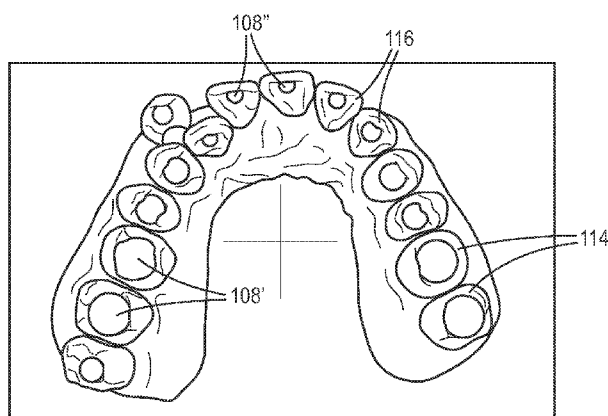


Fig. 4

(57) Abstract: Methods for recognizing a virtual tooth surface, defining a virtual tooth coordinate system, and simulating a collision between virtual teeth are provided. Methods include receiving input data specifying a point on the rendered surface model associated with a tooth, deriving a perimeter on the surface model of the tooth, and analyzing the surface model along a plurality of paths outwardly extending from points on the perimeter. Methods also include receiving point input data, receiving axis input data that defines first and second axes associated with the virtual tooth, computing a substantially normal vector for a portion of the tooth surface surrounding the point, and computing a coordinate system. Methods also include receiving permissible movement input data directed to permissible movement of a first virtual tooth, bringing the first virtual tooth into contact with a second virtual tooth, and displaying data resulting from the simulation.



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INTERNATIONAL SEARCH REPORT

International application No.

PCT/US 12/25605

A. CLASSIFICATION OF SUBJECT MATTER

IPC(8) - A61C 13/34 (2012.01)

USPC - 433/213

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

USPC: 433/213

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
USPC: 264/16, 219, 220, 222; 382/100, 128; 433/167, 229 (keyword limited - see search terms below)

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

PubWEST (PGPB, USPT, USOC, EPAB, JPAB); GOOGLE; Google Scholar

Terms: tooth, arch, model, virtual, simulation, gingival, gum, margin, line, path, point, closed, shape, perimeter, border, boundary, surface, segmentation, isolation, input, pointer, mouse, crosshair, cursor, axis, transform, brackets, user, interface, mesio, distal.

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X --- Y	US 2004/0110110 A1 (Chishti et al.) 10 June 2004 (10.06.2004), abstract, Fig. 1B, para [0018], [0023], [0056], [0058], [0075], [0130], [0132], [0135], [0155], [0197], [0203].	20-25, 27 --- 26
Y	US 2008/0057466 A1 (Jordan et al.) 06 March 2008 (06.03.2008), abstract, para [0021], [0022], [0023].	26
Y	US 2010/0138025 A1 (Morton et al.) 03 June 2010 (03.06.2010), abstract, Fig. 27, para [0007], [0008], [0009], [0080], [0084], [0085], [0117], [0124], [0136]	1-19
Y	US 2002/0102009 A1 (Jones et al.) 01 August 2002 (01.08.2002), abstract, Figs. 2, 10A, 22, para [0002], [0003], [0056], [0061], [0065], [0066], [0077], [0086], [0088], [0090].	1-10
Y	US 2006/0073436 A1 (Raby et al.) 06 April 2006 (06.04.2006), abstract, Fig. 3B, para [0005], [0006], [0023], [0031], [0034], [0035], [0046], [0055].	11-19
Y	US 2005/0271996 A1 (Sporbert et al.) 08 December 2005 (08.12.2005), abstract, para [0016], [0045].	19
A	US 2005/0055118 A1 (Nikolskiy et al.) 10 March 2005 (10.03.2005), entire document	1-27
A	US 2010/0179789 A1 (Sachdeva et al.) 15 July 2010 (15.07.2010), entire document	1-27
A	US 2009/0286196 A1 (Wen et al.) 19 November 2009 (19.11.2009), entire document	1-27

☐ Further documents are listed in the continuation of Box C.



* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search

17 August 2012 (17.08.2012)

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INTERNATIONAL SEARCH REPORT

International application No.

PCT/US 12/25605

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

-- See extra sheet. --

1. ☒ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2. ☐ As all searchable claims could be searched without effort justifying additional fees, this Authority did not invite payment of additional fees.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.
- ☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.
- ☒ No protest accompanied the payment of additional search fees.

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US 12/25605

This application contains the following inventions or groups of inventions which are not so linked as to form a single general inventive concept under PCT Rule 13.1. In order for all inventions to be examined, the appropriate additional examination fees must be paid.

Group I: Claims 1-19; directed to a method for recognizing an element of a tooth.

Group II: Claims 20-27; directed to a method of simulating.

The inventions listed as groups I and II do not relate to a single general inventive concept under PCT Rule 13.1 because, under PCT Rule 13.2, they lack the same or corresponding special technical features for the following reasons:

The special technical feature of group I is receiving point input data that defines a point on the virtual tooth, which is not present in group II. The special technical feature of group II is simulating, in three dimensional space, bringing a first virtual element into contact with a second virtual element, which is not present in group I.

The only elements of commonality between groups I and II are those of a computer-implemented method, which is known in the prior art (ref. US 2009/0026643 A1 to Wiest et al. (29 January 2009); para [0105]--"The control unit 62 controls and manages the processes and data in the system 50 centrally...The control unit 62 can be provided for example by a conventional computer"), receiving into the computer digital data defining, in three-dimensional space, a virtual tooth, which is known in the prior art (ref. US 2009/0026643 A1 to Wiest et al.; para [0099]--"the definition means 42, which is provided by a conventional computer with suitable software, receives three-dimensional geometric data for example for the set of teeth in question"), receiving input data, which is known in the prior art (ref. US 2009/0026643 A1 to Wiest et al.; para [0106]--"The definition means 52 serves to define three-dimensional geometric data and to this end receives inputs from the control unit 62. The extent of these inputs can range from simple basic or even standardised geometric data through to a complete set of three-dimensional geometric data"), and using the computer's processor, which is known in the prior art (ref. US 2009/0026643 A1 to Wiest et al.; para [0106]--"The definition means 52 can also be integrated into the control unit 62 or can be a separate processor or computer").

Groups I-II therefore lack unity of invention under PCT Rule 13 because they do not share a same or corresponding special technical feature.