

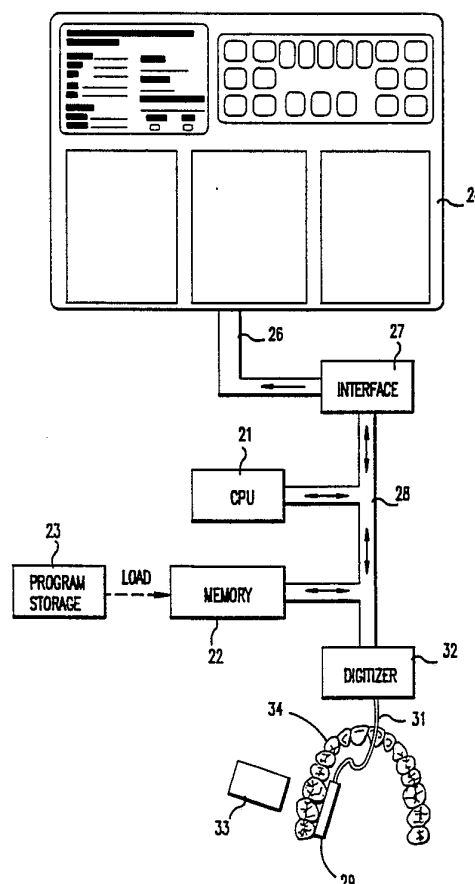


## INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

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<b>(21) International Application Number:</b> PCT/US92/05083 <b>(22) International Filing Date:</b> 17 June 1992 (17.06.92) <b>(30) Priority data:</b> 717,211 17 June 1991 (17.06.91) US <b>(71) Applicant:</b> BOARD OF REGENTS, THE UNIVERSITY OF TEXAS SYSTEM [US/US]; 201 West 7th Street, Austin, TX 78701 (US). <b>(72) Inventors:</b> DOVE, S., Brent ; 12418 Wandering Trail, San Antonio, TX 78284 (US). MCDAVID, W., Doss ; 400 Sagecrest, San Antonio, TX 78232 (US). WILCOX, C., Donald ; 604 N. Cherry, O'Fallon, IL 62269 (US).		<b>(74) Agent:</b> BAHLER, David, D.; Arnold, White & Durkee, P.O. Box 4433, Houston, TX 77210 (US). <b>(81) Designated States:</b> AT, AT (European patent), AU, BB, BE (European patent), BF (OAPI patent), BG, BJ (OAPI patent), BR, CA, CF (OAPI patent), CG (OAPI patent), CH, CH (European patent), CI (OAPI patent), CM (OAPI patent), CS, DE, DE (European patent), DK, DK (European patent), ES, ES (European patent), FI, FR (European patent), GA (OAPI patent), GB, GB (European patent), GN (OAPI patent), GR (European patent), HU, IT (European patent), JP, KP, KR, LK, LU, LU (European patent), MC (European patent), MG, ML (OAPI patent), MN, MR (OAPI patent), MW, NL, NL (European patent), NO, PL, RO, RU, SD, SE, SE (European patent), SN (OAPI patent), TD (OAPI patent), TG (OAPI patent).  <b>Published</b> <i>With international search report.</i> <i>Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.</i>

**(54) Title:** METHOD AND APPARATUS FOR DISPLAYING STORED INTEGRAL RADIOGRAPHS**(57) Abstract**

A method and apparatus for storing and displaying radiographs, particularly intra-oral radiographs, is presented. Radiographs are captured, digitized, and displayed along with an icon of a portion of the anatomy from which the radiograph was taken. The anatomical sites represented by the icon are arranged according to their normal anatomical relationship. The icon is used by the system user to select a portion of the anatomy corresponding to the displayed radiograph, and the radiograph is stored along with indicia of the selected anatomical site. Then, when the stored radiograph is desired to be viewed, the icon is again displayed, and the appropriate anatomical site is selected, which causes the corresponding radiograph to be retrieved from storage and displayed. When processing intra-oral radiographs, the icon can take the form of a dental film holder, with the positions of the film holder corresponding to anatomical sites readily recognized by dentists, each position of the film holder being arranged in anatomical relation to other positions of the film holder icon. An image of dentition, for example, a dental arch, can also be used as an icon to facilitate the storage and display of intra-oral radiographs.



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**METHOD AND APPARATUS FOR DISPLAYING STORED RADIOGRAPHS**

5           The invention relates to methods and apparatus for displaying stored radiographs, particularly intra-oral radiographs.

          It is well known in the field of oral radiology to  
10       mount dental radiographs in a film holder. Use of such film holders minimizes the possibility of misinterpretation of radiographs which, when loose and unmounted, can appear to be quite similar to one another. Such film holders can hold as few as one dental  
15       radiograph, or as many as 20 or more radiographs. Interpretation of such mounted radiographs is facilitated by mounting each film in normal anatomic relation to each other. In other words, each mounting position in a dental film holder corresponds to a particular anatomical  
20       site or anatomical region. Such mounting of dental radiographs also facilitates repeated study and comparison of sets of radiographs taken at different times in order, for example, to assess the progress of a particular dental treatment.

25           In addition, the mounting of dental radiographs in film holders in normal anatomic relation allows a dentist, having knowledge of normal radiologic anatomy and knowledge of anatomical landmarks, to quickly and  
30       easily interpret any set of mounted dental radiographs. The anatomical landmarks used by dentists include: the maxillary molar area (including the posterior wall of the maxillary tuberosity, the hamular process, the coronoid process of the mandible, the maxillary sinus, and the  
35       zygomatic process); the maxillary premolar area (including the maxillary sinus); the maxillary incisor

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area (including the incisive foramen, the cartilage of the nose, the nasal septum, and the nasal fossae); the mandibular molar area (including the external oblique line, the mylohyoid ridge and the mandibular canal); the  
5 mandibular premolar area (including the mylohyoid ridge and the mental foramen); and the mandibular incisor area (including the mental ridges, lingual foramen and the genial tubercles). Film holders present films taken of these anatomical landmark sites in positions that are  
10 consistent from holder to holder.

Recent advances in dental radiology include the use of x-ray sensitive sensors in place of film to produce digitized x-ray images which are stored in a computer  
15 memory and viewed on a computer monitor. In one such computer system, intra-oral x-ray images are created and stored along with information regarding patient identification and the number of the tooth in the image. Sets of images (constituting, for example, a dental  
20 survey), can be stored and recalled for display. When sets of related images are displayed, miniature versions of the images are presented in one portion of the display monitor for selection by the user, and are displayed in another portion of the monitor.

25 However, these miniature representations of the images are in no particular order, requiring the user carefully to assess which image among the set of images is the image desired to be displayed and studied. This  
30 system becomes particularly awkward as the number of images in a set increases given the fact intra-oral radiographs of different anatomical sites can appear to be quite similar.

35 The present invention solves the above-noted drawbacks of the prior art by providing a method and

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apparatus for displaying stored radiographic images which takes advantage of dentists' knowledge of normal radiologic anatomy and knowledge of anatomical landmarks.

5           In particular, the present invention includes an x-ray sensor and x-ray source which are used together to produce images of target anatomical sites. The images are then stored, preferably after digitization, in a computer memory. Then, the display of the stored images  
10 is facilitated by use of a representation or icon of anatomical sites, or of the portion of the anatomy, from which the images were taken. The system user selects the image to be displayed by selecting the appropriate anatomical site from the representation of anatomical  
15 sites or portion of anatomy.

          The preferred application for the present invention is in intra-oral radiology. In such an application, sets of stored radiographs are displayed by using a  
20 representation of a dental film holder, or of dentition such as a dental arch. The system user selects the portion of the representation corresponding to the desired image to be displayed, and the desired image is then retrieved and displayed. Use of a representation of  
25 a dental film holder permits a dentist to use his or her knowledge of the anatomical significance of the positions of the mounting positions in the film holder.

          Thus, the present invention combines the  
30 organizational and interpretational advantages of film holders, with the advantages of digital x-ray imaging techniques.

          Fig. 1 is an apparatus embodying the present  
35 invention.

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Fig. 2 is a screen display, in accordance with the present invention, produced by the apparatus of Fig. 1.

Fig. 3 is another screen display, in accordance with the present invention, produced by the apparatus of Fig. 1.

Figs. 4A and 4B are flow charts of the method of the present invention.

Figs. 5A-S are examples of representations of film holders usable as icons in the present invention.

Figs. 6 and 7 are examples of representations of dentition, usable as icons in the present invention.

Referring to Fig. 1, a computer-based system is presented embodying the present invention.

The computer-based system includes central processing unit (CPU) 21, which, in operation, first loads software embodying the present invention into memory 22 from program storage medium 23. The software of the present invention is presented in flow chart form in Figs. 4a and 4B. Program storage medium 23 can be any machine readable storage medium such as, for example, a floppy or hard magnetic or optical disk, or a programmable read-only memory. The computer system further includes display 24 which is connected in a known manner through display control bus 26, display interface 27, and internal data/address bus 28 to CPU 21. The computer-based system also includes an x-ray sensor 29 which is connected through sensor cable 31, digitizer 32, and internal data/address bus 28 to CPU 21. To acquire x-ray images, sensor 29 is used with x-ray source 33 to produce two-dimensional x-ray images of dentition 34.

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The computer system can be any computer and hardware display. In the preferred embodiment, an IBM AT compatible PC computer, available from Jameco Electronics is used. This preferred computer system includes an  
5 Intel 33 MHz 80386 CPU with 8 megabytes of system RAM, 40 megabytes of hard disk drive, 5.25 and 3.5 inch floppy disk drives, a SuperVGA noninterlaced 1024 x 768 pixel display adapter, a noninterlaced SuperVGA monitor, and an AT 101 key style keyboard. However, other combinations  
10 of commercially available components can also be used without departing from the scope of the invention.

The preferred x-ray sensor is a Sens-A-Ray sensor, available from Regam Medical Systems AB. This preferred  
15 sensor produces a 576 x 386 pixel analog image which is digitized by digitizer 32 before application to data/address bus 28. Digitizer 32 is preferably a frame-grab board available from Regam Medical Systems AB, however, other commercially available image digitizers  
20 can also be used. Digitizer 32 is required in the preferred embodiment because the preferred sensor 29 produces a pixelized analog signal. However, if sensor 29 produced a digital signal, sensor 29 could be connected directly to data/address bus 28, and digitizer  
25 32 could be eliminated.

X-ray source 33 can be any commercially available x-ray source appropriate for the particular application. For example, for intra-oral radiography, x-ray source 33  
30 can be, for example, a type Gendex 1000 x-ray source available from Gendex Corp. Of course, other types of commercially available x-ray sources are also acceptable.

Referring now to Figs. 2 and 3, shown are images  
35 displayed on display 24 (Fig. 1) which are illustrative of the present invention. Referring first to Fig. 2,

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shown is a patient query dialog field 36 and exam/study selection dialog field 37. Patient query dialog field 36 includes several subfields in which are entered patient specific data. For example, subfields 38, 39 and 41 include, respectively, the patient's name, the patient's chart number, and the patient's date of birth. Subfields 42 and 43 respectively display the date and time of examination. Subfields 44 and 46 relate to the referring physician.

10

Subfield 47 displays the modality of the particular examination (for example panoramic, intra-oral, extraoral), and subfield 48 displays the type of examination (for example full mouth, bitewing, complete panorama, cephalometric). Subfield 49 reveals the interpretation status, and subfields 51 and 52 indicate whether the user wishes to interactively choose the images to be displayed (manual), or whether display in a predetermined sequence is desired (CINE).

20

Exam/study selection dialog field 37 lists the various exams which are stored relating to the patient identified in patient query dialog field 36. For example, in Fig. 2, exam/study selection dialog field 37 indicates that five examinations have been completed including a complete panorama, three intra-oral examinations including a full mouth 20-film examination (FMX-20), a 4-film bitewing (BW-4), and a 2-film bitewing (BW-2). The fifth examination is a cephalometric extraoral examination. The entry for each examination in exam/study selection dialog field 37 includes three items: examination modality, examination type, and date of examination. When different examinations are to be selected for review, fields 42, 43, 47 and 48 of patient query dialog fields 37 are updated, as appropriate, by a system user.

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After a particular examination has been selected for review, the screen shown in Fig. 3 is displayed to the system user. Referring to Fig. 3, depicted are patient query dialog field 36 (displaying the same information as in field 36 of Fig. 2), icon or representation field 53, and image display fields 54. Although Fig. 3 depicts three image display fields 54, it will be understood that one or more image fields can be used. In Fig. 3, icon field 53 comprises an image of a full mouth examination 20-film holder. Within the icon in icon field 53 of Fig. 3 are film positions 56-74, each of which relate to a specific anatomical site. Specifically, position 56 is a periapical view of the right maxillary molars, position 57 is a periapical view of the right maxillary premolars, position 58 is a bitewing view of the right maxillary and mandibular molars, position 59 is a bitewing view of the right maxillary and mandibular premolars, position 60 is a periapical view of the right mandibular molars, position 61 is a periapical view of the right mandibular premolars, position 62 is a periapical view of the right maxillary canine area, position 63 is a periapical view of the right maxillary lateral incisor area, position 64 is a periapical view of the maxillary central incisor area, position 65 is a periapical view of the left maxillary lateral incisor area, position 66 is a periapical view of the left maxillary canine area, position 67 is a periapical view of the right mandibular canine area, position 68 is a periapical view of the mandibular central incisor area, position 69 is a periapical view of the left mandibular canine area, position 70 is a periapical view of the left maxillary premolars, position 71 is a periapical view of the left maxillary molars, position 72 is a bitewing view of the left maxillary and mandibular premolars, position 73 is a bitewing view of the left maxillary and mandibular molars, position 74 is a periapical view of the left

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mandibular premolars, and position 75 is a periapical view of the left mandibular molars.

In addition, although the icon illustrated in Fig. 3  
5 comprises an image of a full mouth examination 20-film holder, different examinations may require different icons. For example, the icon appearing in icon field 53 for a 2-film bitewing examination would be that of a 2-film holder, for example as shown in Figs. 5A, 5B or 5C,  
10 described in more detail below.

The flow charts of Figs. 4A and 4B reveal the operation of the apparatus of Fig. 1 in combination with the display screens of Figs. 2 and 3 to practice the  
15 method of the present invention. Fig. 4A relates to capturing and storing radiographs according to the present invention, whereas Fig. 4B relates to retrieving and displaying stored radiographs in accordance with the present invention.

20 Referring to Fig. 4A, after the process has begun, in block 76 a user enters patient specific data using patient query dialog field 36 shown in Fig. 2. Then, in block 76, the user enters exam/study selection data using  
25 exam/study selection dialog field 37, also shown in Fig. 2. Then, control passes to block 78 where the display of Fig. 3 is presented along with an appropriate icon in icon field 53, in accordance with the examination data entered in blocks 76 and 77. Control then passes to  
30 block 79 where, using x-ray source 33, sensor 29 and digitizer 32 (Fig. 1), an x-ray image is captured and displayed in field 54 of Fig. 3. Then, in block 86, the system user uses the icon in field 53 to select the anatomical site within icon 53 that is to be associated  
35 with the x-ray image captured in block 79. Such selection can be accomplished by use of a keyboard,

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mouse, touch-sensitive screen, or other functionally equivalent user input device. After the selection has occurred, control passes to block 82 where the captured image is stored along with indicia of the associated location in the icon. The steps presented in block 79, 81 and 82 are repeated until images have been captured and associated with each of the anatomical sites represented by the icon in field 53. The image capture and store process is then ended.

10

Referring now to Fig. 4B, the image retrieval and display process is presented. After the process is begun, a user enters patient specific data in block 83. Then, in block 84, the set of examinations associated with that patient retrieved. Control then passes to block 86 wherein the display of Fig. 2 is presented including patient specific data in field 36 and study/examination data in field 37. After a particular exam/study is selected for review by the user, control passes to block 87 where the image of Fig. 3 is presented including the appropriate icon in icon field 53. Then, in block 88, the system user selects an image to be displayed by selecting the appropriate anatomical site of the icon in icon field 53. This user selection can be by use of a keyboard, mouse, touch screen, or any other functionally similar user input device. After the particular anatomical site has been selected, control passes to block 89 where the image is displayed. The steps of blocks 88 and 89 can be repeated to display additional images from the examination selected in block 86. The image retrieval and display process is then ended.

Referring now to Figs. 5A-S, presented are various icons of film holders that can be used in the present invention for displaying in icon field 53 (Fig. 3) to

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facilitate user selection of images to be displayed based on desired anatomical site.

Figs. 5A, 5B and 5C are known as 2-film bitewings, Figs. 5D and 5F are examples of 3-film bitewings, Fig. 5E is a 4-film bitewing, and Figs. 5G-S are examples of full mouth surveys having various numbers of films. For each of the film holders depicted in Figs. 5A-S, each of the film positions corresponds to a particular anatomical site within the dental arch.

Figs. 6 and 7 are examples of different types of graphical representations of dentition that can also be used as the icon displayed in icon field 53 (Fig. 3), in accordance with the present invention. The graphical representation of Fig. 6 includes maxillary dental arch 91 and mandibular dental arch 92. The graphical representation of Fig. 7 includes a panorama of maxillary dental arch 93 and a panorama of mandibular dental arch 94. Also depicted in the graphical representation of Fig. 7 are panoramas of immature (baby teeth) maxillary and mandibular dental arches 96 and 97. Tooth numbers are also shown in the graphical representation of Fig. 7, but can be eliminated if desired.

When using the graphical representations of Figs. 6 and 7 as icons in icon field 53 (Fig. 3), user positionable frame 98 can be displayed along with the icon and can be moved (once again by use of a keyboard, mouse, touch-sensitive screen, or functionally equivalent user input device) to select the anatomical site corresponding to the desired image to be stored or displayed.

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**CLAIMS:**

1. A method of displaying stored intra-oral  
5 radiographs, comprising:

displaying a representation of an intra-oral  
radiograph holder including target intra-oral  
radiological sites arranged according to  
10 anatomical location of said sites;

selecting one of said target intra-oral radiological  
sites; and

15 displaying a stored intra-oral radiograph  
corresponding to said selected target intra-  
oral radiological site.

20 2. A method for storing and displaying intra-oral  
radiographs, comprising:

generating and displaying intra-oral radiographs of  
dentition;

25 generating and displaying a representation of an  
intra-oral radiograph holder including  
selectable intra-oral radiological sites  
arranged according to anatomical location of  
30 said sites;

storing said intra-oral radiograph images responsive  
to selection of intra-oral radiological sites  
in said representation along with indicia of  
35 respective selected intra-oral radiological  
sites; and

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subsequently retrieving and displaying said intra-oral radiographs responsive to selection of respective intra-oral radiological sites in said representation.

5

3. A device for storing and displaying intra-oral radiographs, comprising:

10 an x-ray source;

a sensor for producing x-ray images of dentition placed between said source and said sensor;

15 a memory in which said x-ray images are stored;

a display;

20 means for generating and displaying on said display a representation of an intra-oral radiograph holder including selectable intra-oral radiological sites arranged according to anatomical location of said sites; and

25 means, responsive to selection of said selectable sites, for displaying corresponding stored x-ray images.

30 4. The device of claim 3, further comprising:

an image digitizer for digitizing x-ray images produced by said sensor before storage in said memory.

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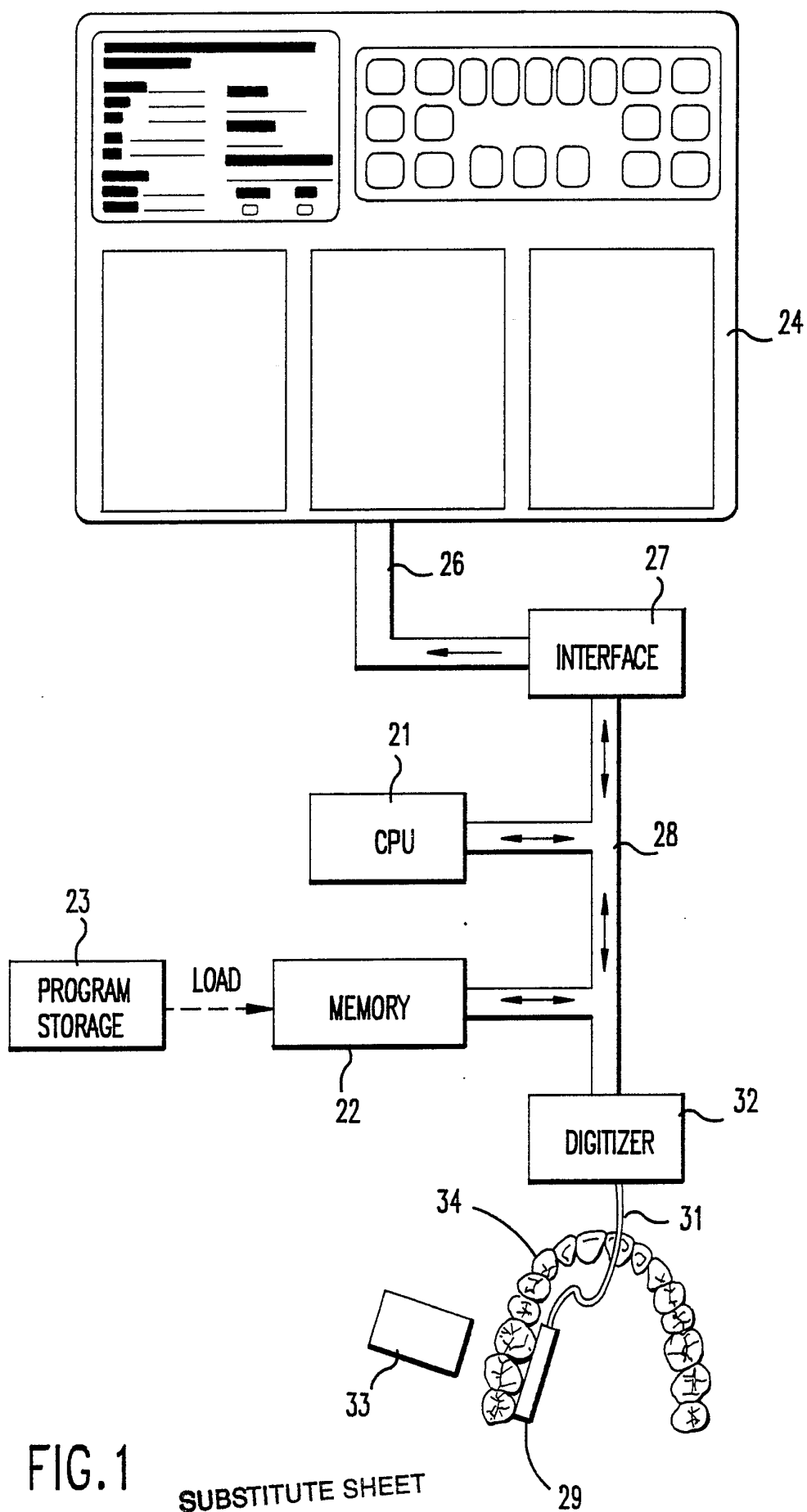


FIG. 1

SUBSTITUTE SHEET

UNIVERSITY OF TEXAS HEALTH SCIENCE CENTER  
DIAGNOSTIC IMAGING

PT. NAME

CHART#

DOB

DOE

TOE

REFERRING DOCTOR

SERVICE

MODALITY

EXAM TYPE

INTERPRETATION STATUS

MANUAL

CINE

36

38

39

41

42

43

44

46

47

48

49

51

52

MODALITY	EXAM TYPE	DATE OF EXAM
PANORAMIC	COMPLETE	5/12/90
INTRAORAL	FMX-20	5/12/90
INTRAORAL	BW-4	8/12/89
INTRAORAL	BW-2	1/25/89
EXTRAORAL	CEPHALOMETRIC	4/4/88

37

FIG.2



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24

UNIVERSITY OF TEXAS HEALTH SCIENCE CENTER  
DIAGNOSTIC IMAGING

PT. NAME

CHART#

DOB

DOE

TOE

REFERRING DOCTOR

SERVICE

MODALITY

EXAM TYPE

INTERPRETATION STATUS

MANUAL

CINE

56

57

58

59

60

61

62

63

64

65

66

67

68

69

70

71

72

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54

54

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SUBSTITUTE SHEET

FIG.3

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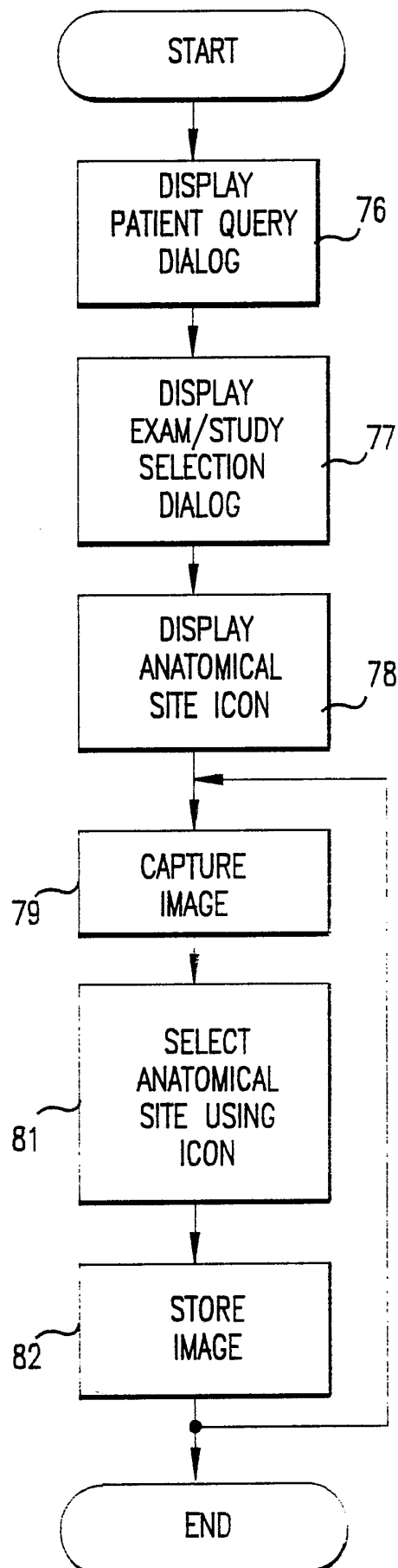


FIG. 4A

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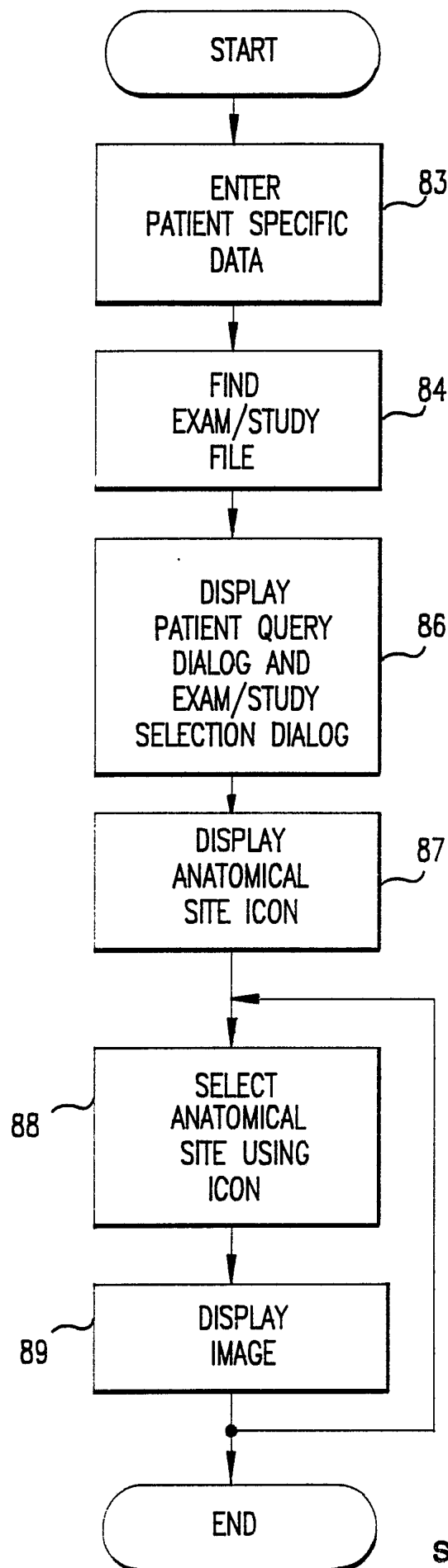


FIG. 4B

SUBSTITUTE SHEET

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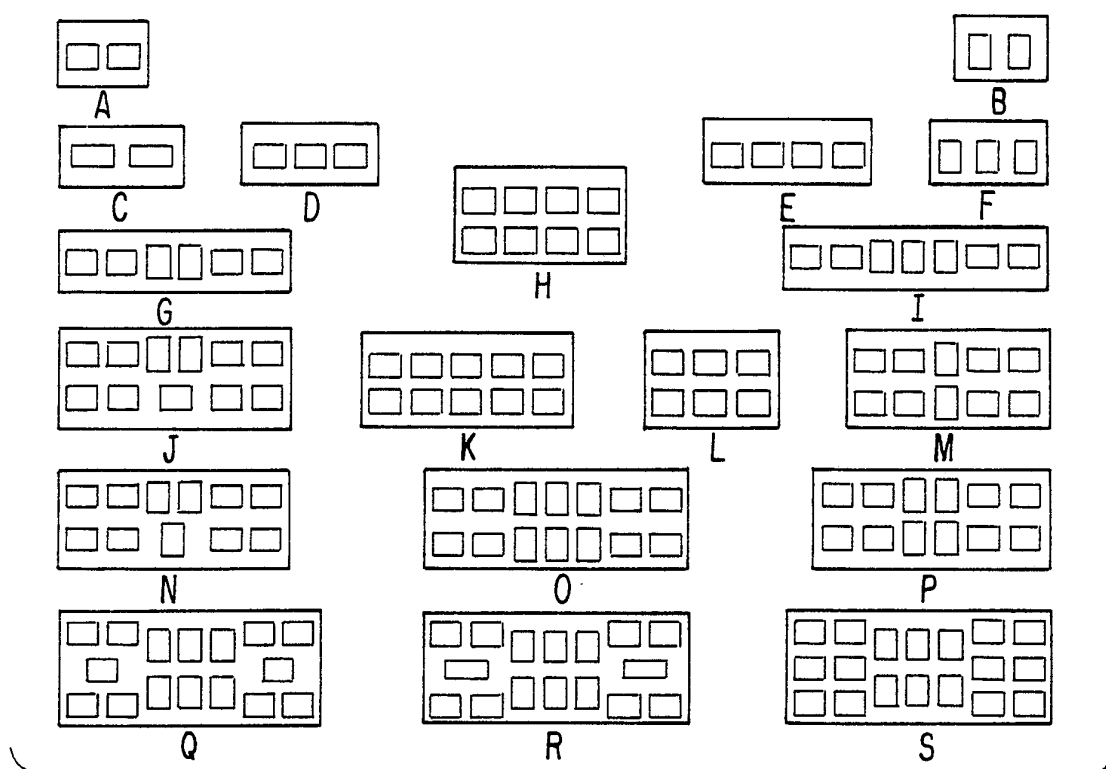


FIG. 5

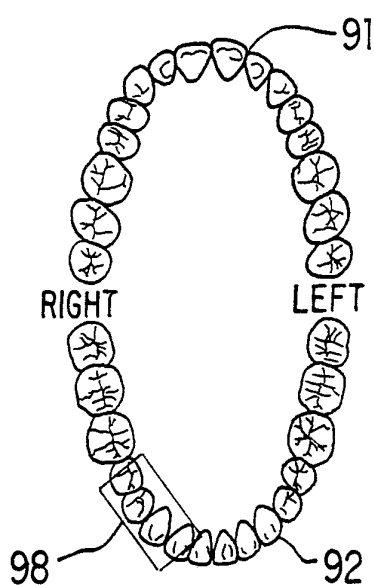
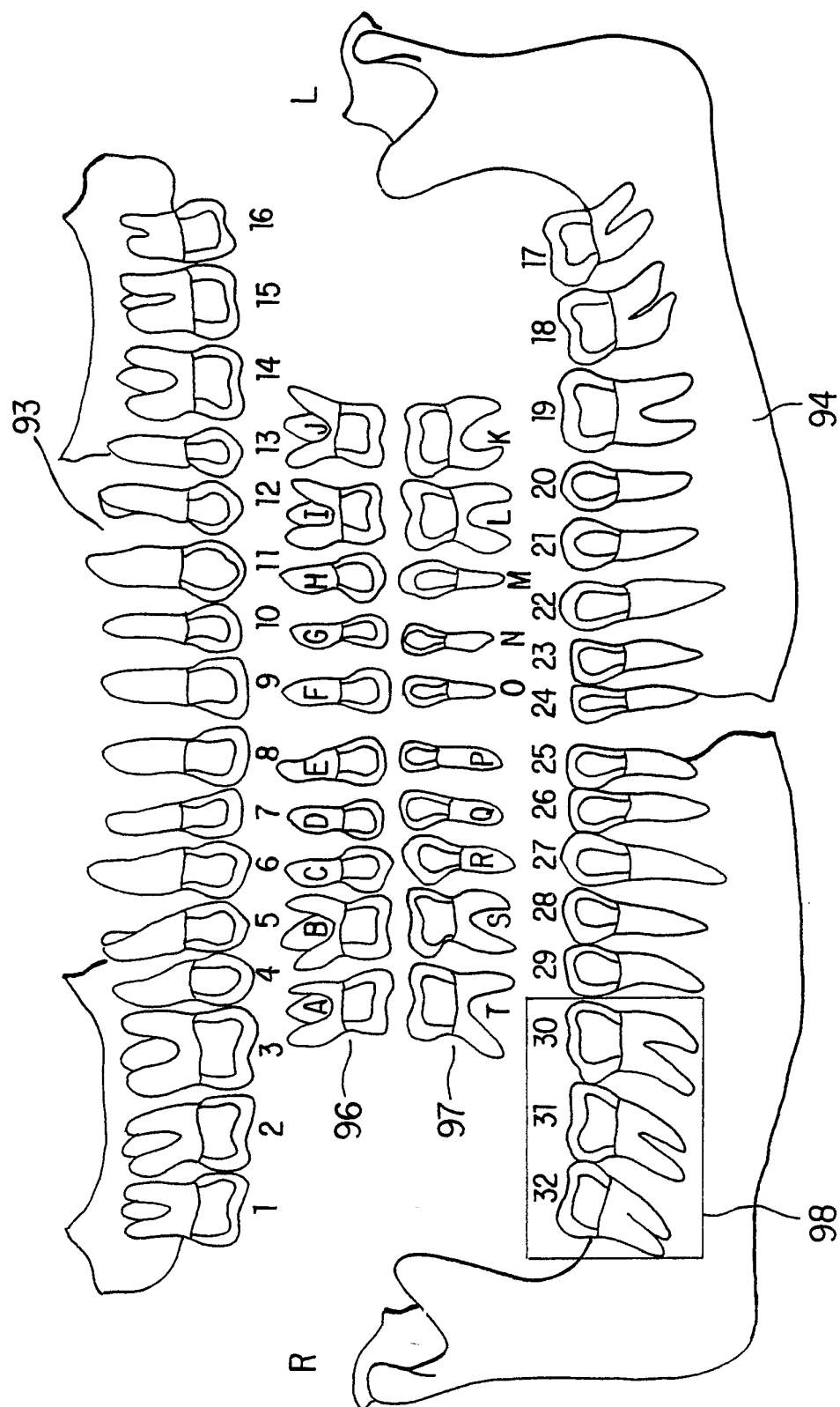


FIG. 6



**FIG. 7**

**SUBSTITUTE SHEET**

<b>I. CLASSIFICATION OF SUBJECT MATTER</b> (if several classification symbols apply, indicate all) <sup>6</sup>		
According to International Patent Classification (IPC) or to both National Classification and IPC		
Int.Cl. 5 G06F15/42; G06F3/023; G06F15/40		
<b>II. FIELDS SEARCHED</b>		
Minimum Documentation Searched <sup>7</sup>		
Classification System	Classification Symbols	
Int.Cl. 5	G06F	
Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched <sup>8</sup>		
<b>III. DOCUMENTS CONSIDERED TO BE RELEVANT<sup>9</sup></b>		
Category <sup>10</sup>	Citation of Document, <sup>11</sup> with indication, where appropriate, of the relevant passages <sup>12</sup>	Relevant to Claim No. <sup>13</sup>
A	<p>INTERNATIONAL JOURNAL OF APPLIED ENGINEERING EDUCATION vol. 6, no. 5, 1990, UK pages 567 - 571 A.WENZEL ET AL 'TECHNICAL DESIGNS FOR AN INTERACTIVE COMPUTER-AIDED PROGRAM SIMULATING A RADIOGRAPHIC UNIT' see page 568, right column, line 10 - line 20 see page 569, left column, line 5 - line 29 see page 569, right column, line 14 - line 17 see page 570, left column, line 28 - line 31</p> <p style="text-align: center;">---</p> <p style="text-align: right;">-/--</p>	1-4
<p><sup>10</sup> Special categories of cited documents:</p> <p>"A" document defining the general state of the art which is not considered to be of particular relevance</p> <p>"E" earlier document but published on or after the international filing date</p> <p>"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)</p> <p>"O" document referring to an oral disclosure, use, exhibition or other means</p> <p>"P" document published prior to the international filing date but later than the priority date claimed</p> <p>"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</p> <p>"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step</p> <p>"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.</p> <p>"&amp;" document member of the same patent family</p>		
<b>IV. CERTIFICATION</b>		
Date of the Actual Completion of the International Search		Date of Mailing of this International Search Report
15 OCTOBER 1992		05.11.92
International Searching Authority		Signature of Authorized Officer
EUROPEAN PATENT OFFICE		BARBA M.

III. DOCUMENTS CONSIDERED TO BE RELEVANT (CONTINUED FROM THE SECOND SHEET)		Relevant to Claim No.
Category <sup>a</sup>	Citation of Document, with indication, where appropriate, of the relevant passages	
X	<p>SPIE MEDICAL IMAGING III: PACS SYSTEM            DESIGN AND EVALUATION            vol. 1093, 1990,            pages 122 - 132            J.C.GEE ET AL 'USER INTERFACE DESIGN FOR A            RADIOLOGICAL IMAGING WORKSTATION'            see the whole document</p> <p>---</p>	1-4
X	<p>SPIE MEDICAL IMAGING IV            vol. 1234, 1990,            pages 532 - 540            H.S.CHOI ET AL 'DEVELOPMENT OF A PROTOTYPE            ELECTRONIC ALTERNATOR FOR A DIN/PACS            ENVIROMENT AND ITS EVALUATION'            see page 535, line 20 - line 34</p> <p>---</p>	1-4
X	<p>SPIE MEDICAL IMAGING IV            vol. 1232, 1990,            pages 246 - 256            K.S.MILLS ET AL 'A HIGH PERFORMANCE            FLOATING POINT IMAGE COMPUTING WORK            STATION FOR MEDICAL APPLICATIONS'            see page 252, line 3 - page 254, line 49</p> <p>---</p>	1-4
A	<p>PROCEEDINGS OF THE ISMII 84 IEEE            INTERNATIONAL SOCIETY SYMPOSIUM ON MEDICAL            IMAGES AND ICONS; IEEE COMP. SOC.PRESS,            NEW YORK, US 24 July 1984, ARLINGTON, VA,            US            pages 218 - 221            R.A.J. GROENHUIS ET AL 'A PROTOTYPE            DIGITAL TOMOGRAPHIC X-RAY SYSTEM FOR            DENTAL APPLICATIONS'            see page 218, left column, line 4 - line            19            see page 219, right column, line 46 - line            64            see page 220, left column, line 1 - line            17            see page 220, left column, line 57 - right            column, line 15</p> <p>---</p>	1-4
A	<p>PATENT ABSTRACTS OF JAPAN            vol. 7, no. 125 (P-200)(1270) 31 May 1983            &amp; JP,A,58 43 028 ( MAEDA SEISAKUSHO K.K. )            12 March 1983            see abstract</p> <p>---</p> <p>-/--</p>	2,3

III. DOCUMENTS CONSIDERED TO BE RELEVANT (CONTINUED FROM THE SECOND SHEET)		
Category °	Citation of Document, with indication, where appropriate, of the relevant passages	Relevant to Claim No.
A	<p>PROCEEDINGS OF COMPUTERS IN CARDIOLOGY, IEEE COMPUTER SOCIETY PRESS, NEW YORK, US 25 September 1988, WASHINGTON D.C., US pages 457 - 460 , XP000145691 J.W.KLINGER ET AL 'USING HYPERMEDIA TO TEACH CARDIOVASCULAR IMAGING: A PROTOTYPE SYSTEM BASED ON HYPERCARD' see page 38, left column, line 38 - right column, line 34 see page 459, right column, line 3 - line 29</p> <p style="text-align: center;">---</p>	1,2
A	<p>IMAGE PROCESSING vol. 3, no. 2, May 1991, pages 27 - 29 S.GEORGIU ET AL 'SCANNING THE HEADLINES (CEPHALOGRAPHIC ANALYSIS' see page 27, left column, line 20 - right column, line 4 see page 27, right column, line 20 - line 25 see page 28, left column, line 1 - line 8 see page 28, column C, line 3 - right column, line 35 see page 29, left column, line 8 - line 13 see page 29, left column, line 32 - column C, line 17</p> <p style="text-align: center;">---</p>	1-4
A	<p>MEDINFO 89. PROCEEDINGS OF THE SIXTH CONF. ON MEDICAL INFORMATICS, NORTH HOLLAND, NL vol. 2, 16 October 1989, BEIJING, CHINA pages 722 - 724 J.F.CRAIG ET AL 'INTERACTIVE VIDEODISC APPLICATIONS IN DENTAL EDUCATION. A CASE STUDY IN ORAL HISTOLOGY' see page 722, left column, line 14 - line 27 see page 723, left column, line 45 - line 50 see page 723, right column, line 57 - page 724, left column, line 29</p> <p style="text-align: center;">-----</p>	1,2