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

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
7 May 2015 (07.05.2015)

WIPO | PCT

(10) International Publication Number
WO 2015/066565 A1

(51) International Patent Classification:
G09B 5/00 (2006.01)

(21) International Application Number:
PCT/US2014/063595

(22) International Filing Date:
31 October 2014 (31.10.2014)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
61/898,272 31 October 2013 (31.10.2013) US

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(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, JP, KE, KG, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, ST, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

[Continued on next page]

(54) Title: SYSTEM AND METHOD FOR A SITUATION AND AWARENESS-BASED INTELLIGENT SURGICAL SYSTEM

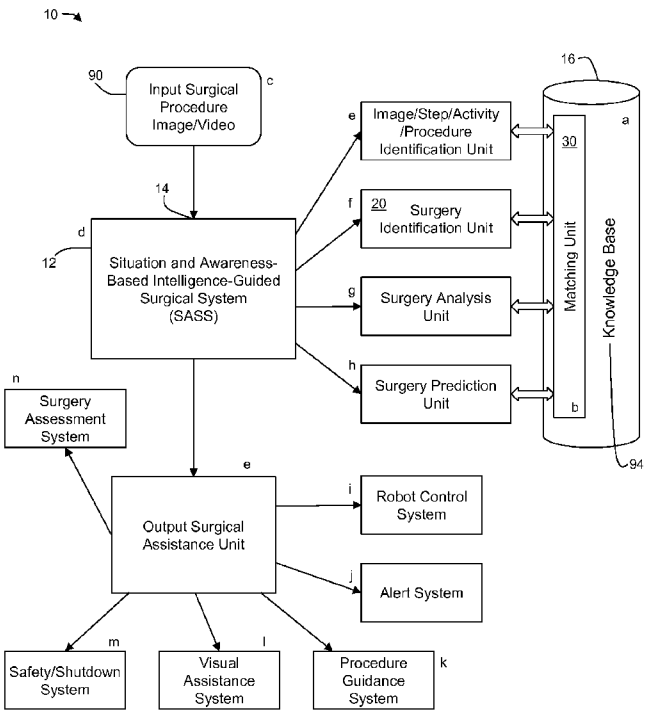

Fig. 1

(57) **Abstract**: A computer-based method includes receiving a video feed of a surgical procedure; identifying a current step of the surgical procedure using the video feed and an electronic surgical database; and determining an expected next step of the surgical procedure. A similarity of the expected next step with the actual next step of the surgical procedure may be determined, and an alert and/or surgical guidance may be provided based on the similarity (or lack of). A system for surgical-guidance is disclosed, the system having a storage unit with an electronic surgical database; a surgery image identification unit for analyzing a video feed to determine characteristic data; a mapping unit for matching a database record based on the characteristic data; an alignment unit for mapping matched database records with a stored surgical procedure; and a surgery prediction unit for determining a predicted next surgical step.

WO 2015/066565 A1

Published:

— *with international search report (Art. 21(3))*

SYSTEM AND METHOD FOR A SITUATION AND AWARENESS-BASED INTELLIGENT SURGICAL SYSTEM

Cross-Reference to Related Applications

[0001] This application claims priority to U.S. Provisional Application No. 61/898,272, filed on October 31, 2013, the disclosure of which is incorporated herein by reference.

Field of the Disclosure

[0002] The disclosure relates to surgical guidance, and in particular to automated surgical guidance by an intelligent system using surgical information stored in an electronic database.

Background of the Disclosure

[0003] Many surgeries can be broken down into a series of surgical steps performed in a pre-determined order to accomplish the desired result of the surgery. As such, a surgery is also commonly referred to as a surgical procedure. Each of the surgical steps may correspond with one or more surgical activities. For example, a surgical step wherein two anatomical objects are reconnected may involve the surgical activity of suturing the objects with one another.

[0004] Medical professionals must often rely on each other to detect errors or provide guidance during a typical surgical procedure. However, outside of an educational setting, it is not common for a sufficiently skilled/educated professional to be available to simply monitor the progress of a surgical procedure. Accordingly, there is a need for an automated system and method which can monitor a surgical procedure and provide guidance to the professionals conducting the procedure.

Brief Summary of the Disclosure

[0005] A computer-based method for surgical guidance is presented. Embodiments of the method include receiving a video feed of a surgical procedure, the video feed comprising a plurality of image frames; identifying a current step of the surgical procedure based on one or more image frames of the video feed and using an electronic surgical database; and determining an expected next step of the contemporaneous surgical procedure. In some embodiments, identifying a current surgical activity of the surgical procedure based on the one or more image frames of the video feed and using the electronic surgical database; and determining the current

step of the surgical procedure based on the identified current surgical activity and the electronic surgical database.

[0006] In some embodiments, identifying a current surgical activity includes extracting features of the one or more image frames and matching the extracted features with features of known surgical activities stored in the electronic surgical database.

[0007] The method may further comprise determining a similarity of the expected next step with an actual next step of the contemporaneous surgical procedure and providing an alert if the similarity of the expected next step and the actual next step does not exceed a pre-determined threshold. The method may further comprise providing surgical guidance including the expected next step. The surgical guidance may be in the form of audible instruction, visual instruction, a control signal to a robotic system, or other guidance which will be apparent to those having skill in the art in light of the present disclosure. The method may include the step of providing control signals to a robotic system, such as, for example, a surgical robot.

[0008] The present disclosure may be embodied as a system for surgical-guidance of a contemporaneous surgery using a video feed of the surgery, comprising a storage unit with an electronic surgical database stored therein; a surgery image identification unit configured to receive the video feed and analyze one or more image frames of the video feed to determine characteristic data; a mapping unit configured to determine a matched database record of the electronic surgical database based on the characteristic data of the surgery image identification unit; an alignment unit configured to map one or more matched database records of the mapping unit with a surgical procedure stored within the electronic surgical database; and a surgery prediction unit for determining a predicted next step of the contemporaneous surgery based on the mapped surgical procedure of the alignment unit.

[0009] In another embodiment, a computer-based system for surgical-guidance of a contemporaneous surgical procedure using a video feed of the surgery is provided. Such a system comprises a processor; a communications adapter in electronic communication with the processor and configured to receive the video feed; and a storage medium in electronic communication with the processor and containing an electronic surgical database. The processor is programmed to implement any of the methods disclosed herein. In an exemplary embodiment, the processor is programmed to receive the video feed of a surgical procedure using the communications adapter, the video feed comprising a plurality of image frames; identify a

current step of the surgical procedure based on one or more image frames of the video feed and using the electronic surgical database of the storage medium; and determine an expected next step of the contemporaneous surgical procedure.

Description of the Drawings

[0010] For a fuller understanding of the nature and objects of the disclosure, reference should be made to the following detailed description taken in conjunction with the accompanying drawings, in which:

Figure 1 is a diagram depicting a system according to an embodiment of the present disclosure;

Figure 2 is a diagram depicting a structure of an electronic surgical database for use in an embodiment of the present disclosure;

Figure 3 is a diagram showing the relationship between surgical procedures, surgical steps, surgical activities, and image frames of a surgical video feed;

Figure 4 is a diagram of a surgery image identification unit for use in an embodiment of the present disclosure;

Figure 5 is a diagram of a mapping unit for use in an embodiment of the present disclosure;

Figure 6 is a diagram of an alignment unit for use in an embodiment of the present disclosure;

Figure 7 is a diagram of a surgery prediction unit for use in an embodiment of the present disclosure;

Figure 8 depicts where an image frame (upper left) of a video feed has been matched with six likely matches in an electronic surgical database (image on right side) using the derived feature shown in a plurality of images (lower left);

Figure 9 is a flowchart of a method according to an embodiment of the present disclosure; and

Figure 10 is a flowchart of a method according to another embodiment of the present disclosure.

Detailed Description of the Disclosure

[0011] The present disclosure may be embodied as a method **100** for surgical guidance. A computer-based monitoring system is provided with an electronic surgical database, which contains annotated surgical procedure information and match data. The electronic surgical database (Fig. 2) may comprise database records corresponding to surgical procedures, wherein each surgical procedure record may correspond with one or more surgical steps. In the database embodiment depicted in Fig. 2, the surgical steps correspond to one or more stored images each annotated with characteristics such as, for example, extracted image features, image segments, labeled activities, labeled instruments, labeled anatomy, etc.

[0012] The method **100** comprises the step of receiving **103** a video feed of a surgical procedure. In an embodiment, the received **103** video feed is of a contemporaneous surgical procedure such that the video feed is received **103** in real-time or near real-time. In some embodiments, near real-time includes a video feed delayed by the latency inherent in the transmission. In other embodiments, the video feed may have delays caused by other factors. The video feed comprises a plurality of image frames. The image frames are generally received consecutively, in chronological order. The video feed may be a two-dimensional (2D) video or a three-dimensional (3D) video. For example, a 3D video feed may comprise a plurality of stereoscopic sets of image frames. For simplicity, embodiments of the present disclosure using stereoscopic sets of image frames (or other formats of 3D image/video information) are included in the present description of 2D image frames. In other words, reference herein to a plurality of image frames in a video feed should be broadly interpreted to include embodiments having a plurality of sets of stereoscopic image frames.

[0013] The method **100** comprises identifying **106** a current step of the surgical procedure based on one or more image frames of the received **103** video feed and using the electronic surgical database. In an example, identifying **106** the current step may include analyzing an image frame of the video frame to determine characteristics of the image frame for matching with the match data of the electronic surgical database. Similarly, more than one image frame may be utilized to determine characteristics of the actions in the more than one image frames for matching with the match data. Image-based and action-based techniques are known in the art and one or more such techniques may be used in the present disclosure. For example, feature selection techniques may be used in order to extract features of the image frame(s) and

match with extracted features of the match data. Other techniques may include, for example, parametric, nonparametric, geometric, and spectral-based computer vision methods (*e.g.*, template matching, feature selection, clustering, classification, etc.) The location of surgical instruments or patient anatomy may also be used to identify **106** the current step.

[0014] To identify **106** the current step, a match probability may be calculated and the resulting surgical step is determined from the annotated surgical information corresponding to the most probable match within the electronic surgical database. Once the current surgical step is identified **106**, an expected next step of the surgical procedure may be determined **109** using the electronic surgical database.

[0015] In an example, an electronic surgical database may include the surgical steps of a prostatectomy (the surgical procedure). The database contains database records for the surgical steps of the prostatectomy including image and/or action matching information for each step. In an exemplary embodiment of the present method **100**, a video feed is received **103** of a contemporaneous prostatectomy. An image frame of the received **103** video feed is analyzed to extract features and the features are compared to the image matching information contained within each database record of the database to determine the most probable match. A database record determined to be the most probable match is used to identify **106** the current surgical step. For example, the image frame may show a dissection taking place, and this image frame is matched to a database record for a dissection surgical step. Once the current surgical step is identified **106**, an expected next surgical step can be determined **109** using the electronic database. For example, the matched database record for dissection may include information regarding the next surgical step (*e.g.*, a link to the database record for the next step in the prostatectomy).

[0016] The present disclosure is particularly well suited to minimally-invasive surgeries ("MIS"), including, for example, robotically-assisted surgeries, because video feeds are often inherent to such surgeries. Additionally, the point of view of such MIS video feeds is typically the same from surgery to surgery for the same surgical procedure.

[0017] The step of identifying **106** a current step of the surgical procedure may comprise the sub-steps of identifying **112** a current surgical activity of the surgical procedure. For example, in the exemplary embodiment of a prostatectomy described above, the surgical step of dissection may correspond to one or more surgical activities such as cutting using a scalpel tool.

In such an example, the surgical activity of cutting using a scalpel tool may be identified **112** and the current step of dissection may then be determined **115** based on the identified cutting activity (*e.g.*, in an example where there are no other surgical steps involving the activity of cutting using a scalpel).

[0018] The step of identifying **106** a current step of the surgical procedure may be repeated and the resulting plurality of steps may be aligned and mapped **118** to a surgical procedure stored in the electronic surgical database. In this way, a surgical procedure may be identified where it is not known *a priori.*

[0019] The step of identifying a current surgical step may further comprise extracting features of the one or more image frames of the video feed. Such feature extraction techniques are known in the art of computer vision. The extracted features may be probabilistically matched to one or more database records of the electronic surgical database. The database records may comprise images (annotated, labeled, or otherwise identified). In other embodiments, the database records may store extracted features instead of, or in addition to, stored images. In this way, feature extraction does not need to be performed on the stored images at the time of matching with the image frames of the video feed. Instead, the pre-determined and stored features may be matched more efficiently.

[0020] The method **100** of the present disclosure may further comprise the step of determining **140** a similarity of the expected next step with an actual next step of the contemporaneous surgical procedure (as identified using the video feed). The determined **140** similarity may be used to provide **143** specific guidance for the surgeon or other medical professional. For example, where the determined **140** similarity is low, an alert may be provided **146** (*e.g.*, audible, visual, tactile, or combination, etc.) In this way, errors in the surgical procedure may be identified and corrected before causing harm.

[0021] In other embodiments, the determined **140** similarity may be used to provide qualitative feedback on the surgical procedure. For example, the method **100** may be used in an educational/instructional setting to provide **149** feedback on how well one or more steps of the surgical procedure were performed based on the determined **140** similarity to the steps modeled in the electronic surgical database.

[0022] In other embodiments, the system may be used to provide control signals to a surgical robot. The determined **140** similarity may be used to provide **152** control signals to a surgical robot. For example, the method may be used to stop the robotic instruments, or stop the operator on the maser console, or move the robot instruments to a specified location.

[0023] In other embodiments, the determined **140** similarity may be used to halt **155** the surgery until corrective measures can take place. For example, in a robotically-assisted surgery, the master console may be disconnected from the slave(s) such that the operator at the master console can no longer move the slave(s).

[0024] The present disclosure may be embodied as a system **10** for providing surgical guidance. Such a system **10** can be referred to as a "Situation and Awareness-based Intelligence-Guided Surgical System" or "SASS." With reference to Figure 1, the system **10** comprises a processing unit **12**, which may be, for example, a computer. The processing unit **12** comprises a communications adapter **14** configure to receive a video feed **90**. For example, the communications adapter **14** may be a network card for connection to a computer network, and the video feed **90** is received using a communication protocol over the computer network. The processing unit **12** is in electronic communication with a storage unit **16** wherein an electronic surgical database **94** is stored. The storage unit **16** may be a part of the processing unit **12** or separate from the processing unit **12** (*e.g.*, and in communication with the processing unit **12** by way of the communications adapter **14**).

[0025] The system **10** further comprises a surgery image identification unit **20** (Figure 4). The surgery image identification unit **20** may form a part of the processing unit **12** or may be separate from the processing unit **12** (an in electronic communication with the processing unit **12**). The surgery image identification unit **20** is configured to analyze the video feed **90** received by the processing unit **12** to determined characteristics of one or more image frames of the video feed **90** according to computer vision techniques. For example, the surgery image identification unit **20** may be configured to perform a feature extraction on one or more image frames. The surgery image identification unit **20** may be further configured to segment the image(s).

[0026] The system **10** further comprises a mapping unit **30** (Figure 5). The mapping unit **30** may form a part of the processing unit **12** or may be separate from the processing unit **12** (an in electronic communication with the processing unit **12**). The mapping unit **30** is configured

to compare the analysis data of the surgery image identification unit **20** to the corresponding data of one or more database records in the electronic surgical database **94**. For example, the mapping unit **30** may provide a match probability for a match between the analysis data and the one or more database records.

[0027] The system **10** (for example, in the surgery image identification unit **20**) is further configured to identify database record which is the match of the analysis data and to associate a label of the identified database record with the images which were analyzed (described above). The label may be of a surgical step, a surgical activity, and/or a portion of the anatomy.

[0028] The system **10** may be configured to repeat the above analysis for one or more additional image frames of the video feed **90**. The analyzed image frames may be consecutive to the previously analyzed image frames, overlapping with the previously analyzed image frames, or separate from (over time) the previously analyzed image frames.

[0029] The system **10** may further comprise an alignment unit **50** (Figure 7), which may form a part of the processing unit **12** or may be separate from the processing unit **12**. The alignment unit **50** is configured to receive the labeled surgical steps resulting from the repeated analysis of image frame(s) and map the labeled steps (and the associated order of such labeled steps) with a known surgical procedure contained in the electronic surgical database. For example, if the analyzed and labeled image frames correspond with the surgical steps of dissection, extraction/removal, connection/suturing, the surgical procedure may be identified as a prostatectomy (of course, this example is greatly simplified for convenience).

[0030] The system **10** may further comprise a surgery prediction unit **60** (Figure 7), which may form a part of the processing unit **12** or may be separate from the processing unit **12**. The surgery prediction unit **60** is configured to receive surgical procedure information from the alignment unit **50** and labeled surgical information from, for example, the surgery image identification unit **20**, and determine, using the electronic surgical database **94**, a predicted next surgical step.

[0031] The system **10** may be configured to perform any of the disclosed methods to provide surgical guidance. It is to be appreciated that the processor unit **12**, the surgery image identification unit **20**, the mapping unit **30**, the alignment unit **50**, and/or the surgery prediction unit **60** may be implemented in practice by any combination of hardware, software, and

firmware. Where a unit is implemented in software, the associated program code or instructions may be stored in a processor-readable, non-transitory storage medium, such as a memory.

[0032] Although the present disclosure has been described with respect to one or more particular embodiments, it will be understood that other embodiments of the present disclosure may be made without departing from the spirit and scope of the present disclosure. Hence, the present disclosure is deemed limited only by the appended claims and the reasonable interpretation thereof.

What is claimed is:

1. A computer-based method for surgical guidance, the method comprising:
receiving a video feed of a surgical procedure, the video feed comprising a plurality of image frames;
identifying a current step of the surgical procedure based on one or more image frames of the video feed and using an electronic surgical database; and
determining an expected next step of the contemporaneous surgical procedure.

2. The method of claim 1, wherein the step of identifying a current step of the surgical procedure comprises:
identifying a current surgical activity of the surgical procedure based on the one or more image frames of the video feed and using the electronic surgical database; and
determining the current step of the surgical procedure based on the identified current surgical activity and the electronic surgical database.

3. The method of claim 1, wherein the step of identifying a current surgical activity comprises:
extracting features of the one or more image frames; and
matching the extracted features with features of known surgical activities stored in the electronic surgical database.

4. The method of claim 1, further comprising:
determining a similarity of the expected next step with an actual next step of the contemporaneous surgical procedure; and
providing an alert if the similarity of the expected next step and the actual next step does not exceed a pre-determined threshold.

5. The method of claim 1, further comprising providing surgical guidance comprising the expected next step.

6. The method of claim 5, wherein the surgical guidance is audible instruction.

7. The method of claim 5, wherein the surgical guidance is visual instruction.

8. The method of claim 5, wherein the surgical guidance is control signal to a robotic system.

9. The method of claim 1, further comprising providing one or more control signals to a robotic system.

10. A system for surgical-guidance of a contemporaneous surgery using a video feed of the surgery, comprising:

a storage unit comprising an electronic surgical database stored therein;

a surgery image identification unit configured to receive the video feed and analyze one or more image frames of the video feed to determine characteristic data;

a mapping unit configured to determine a matched database record of the electronic surgical database based on the characteristic data of the surgery image identification unit;

an alignment unit configured to map one or more matched database records of the mapping unit with a surgical procedure stored within the electronic surgical database; and

a surgery prediction unit for determining a predicted next step of the contemporaneous surgery based on the mapped surgical procedure of the alignment unit.

11. A computer-based system for surgical-guidance of a contemporaneous surgical procedure using a video feed of the surgery, comprising:

a processor;

a communications adapter in electronic communication with the processor and configured to receive the video feed;

a storage medium in electronic communication with the processor and containing an electronic surgical database; and

wherein the processor is programmed to:

receive the video feed of a surgical procedure using the communications adapter, the video feed comprising a plurality of image frames;

identify a current step of the surgical procedure based on one or more image frames of the video feed and using the electronic surgical database of the storage medium; and

determine an expected next step of the contemporaneous surgical procedure.

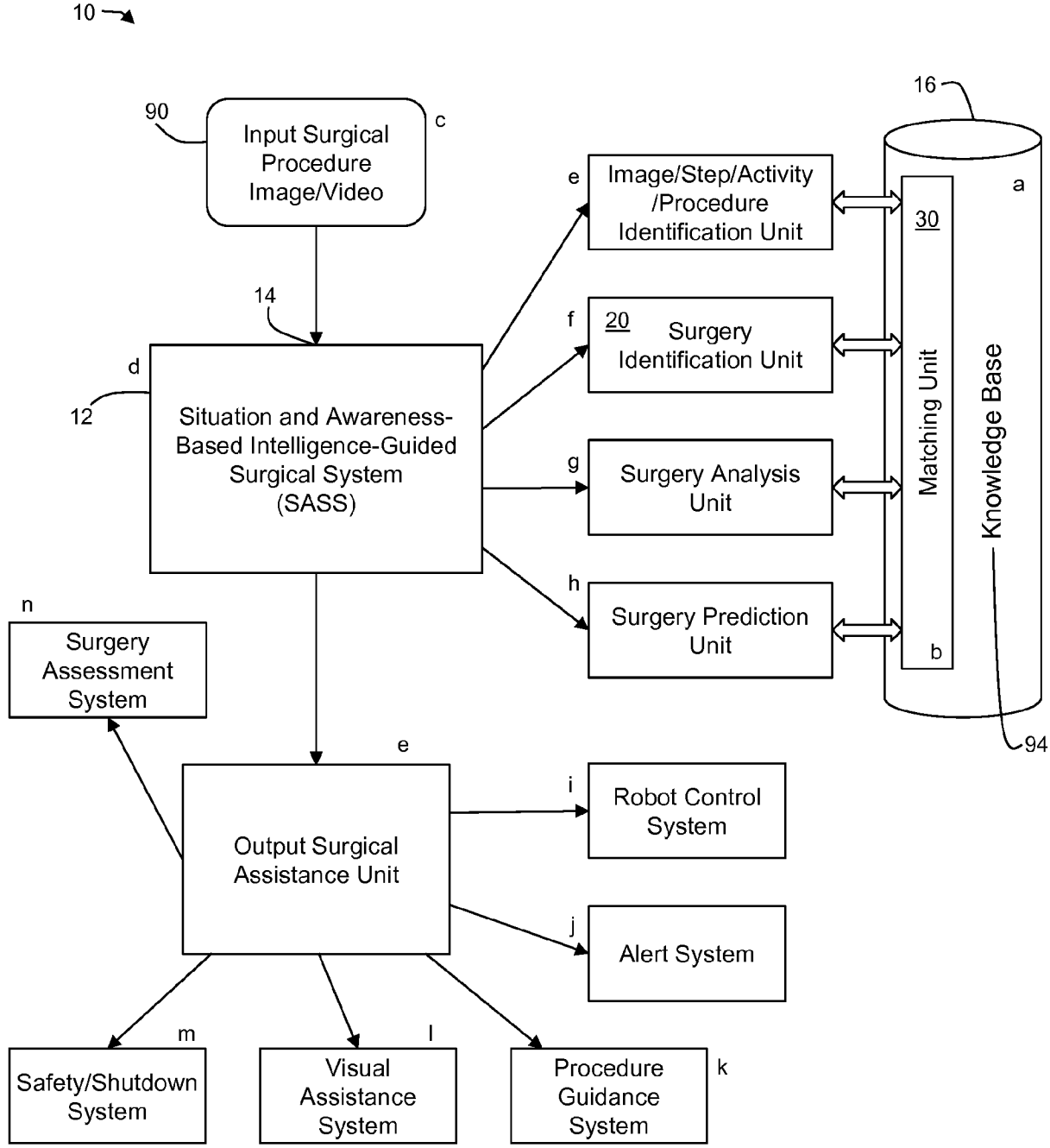
10
90
Input Surgical Procedure Image/Video
c
16
a
e
Image/Step/Activity /Procedure Identification Unit
30
14
f
20
Surgery Identification Unit
d
12
Situation and Awareness-Based Intelligence-Guided Surgical System (SASS)
g
Surgery Analysis Unit
Matching Unit
Knowledge Base
h
Surgery Prediction Unit
b
n
Surgery Assessment System
94
e
i
Robot Control System
Output Surgical Assistance Unit
j
Alert System
m
l
k
Safety/Shutdown System
Visual Assistance System
Procedure Guidance System

Fig. 1

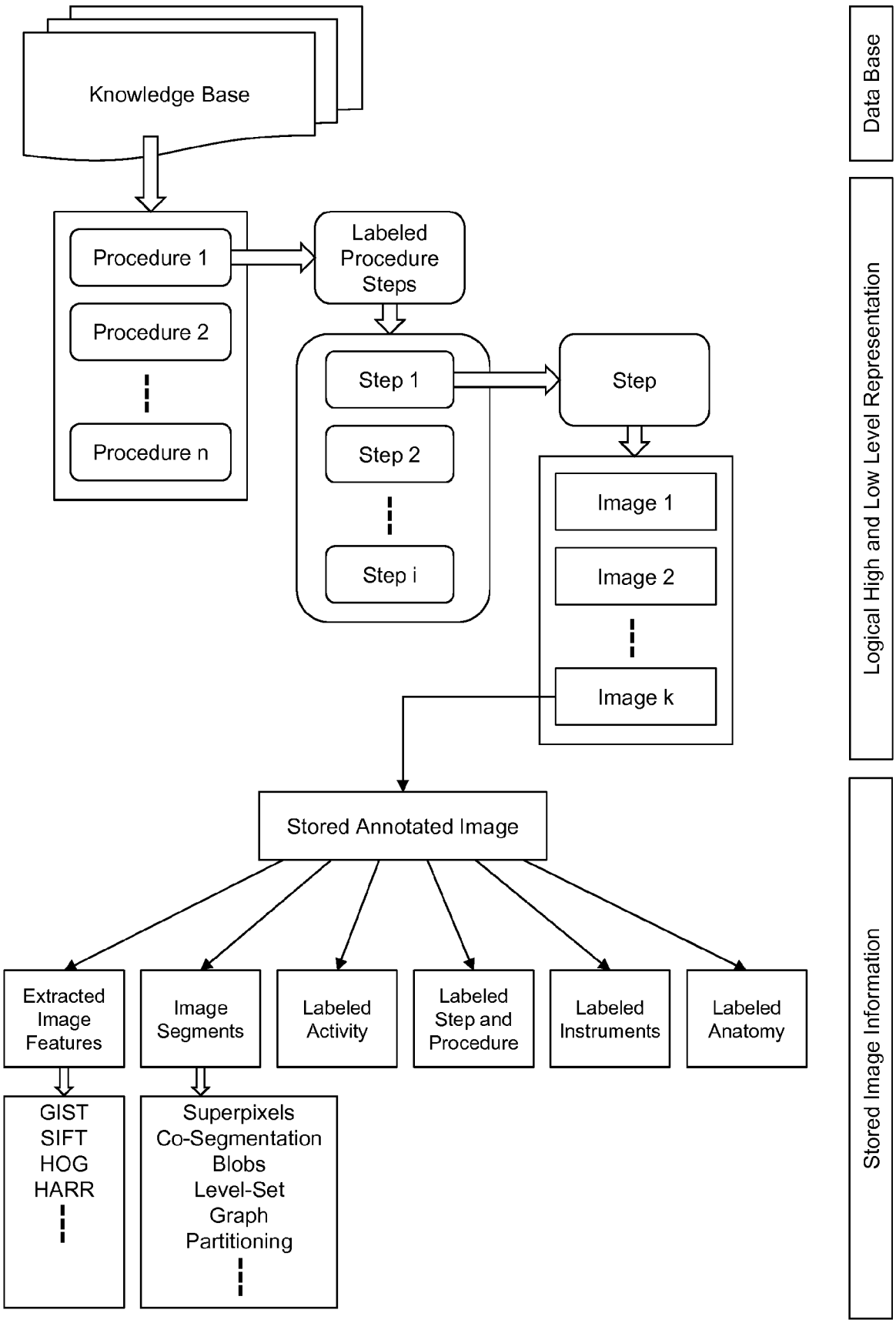
Knowledge Base
Procedure 1
Procedure 2
Procedure n
Labeled Procedure Steps
Step 1
Step 2
Step i
Step
Image 1
Image 2
Image k
Stored Annotated Image
Extracted Image Features
Image Segments
Labeled Activity
Labeled Step and Procedure
Labeled Instruments
Labeled Anatomy
GIST
SIFT
HOG
HARR
Superpixels
Co-Segmentation
Blobs
Level-Set
Graph
Partitioning
Data Base
Logical High and Low Level Representation
Stored Image Information

Fig. 2

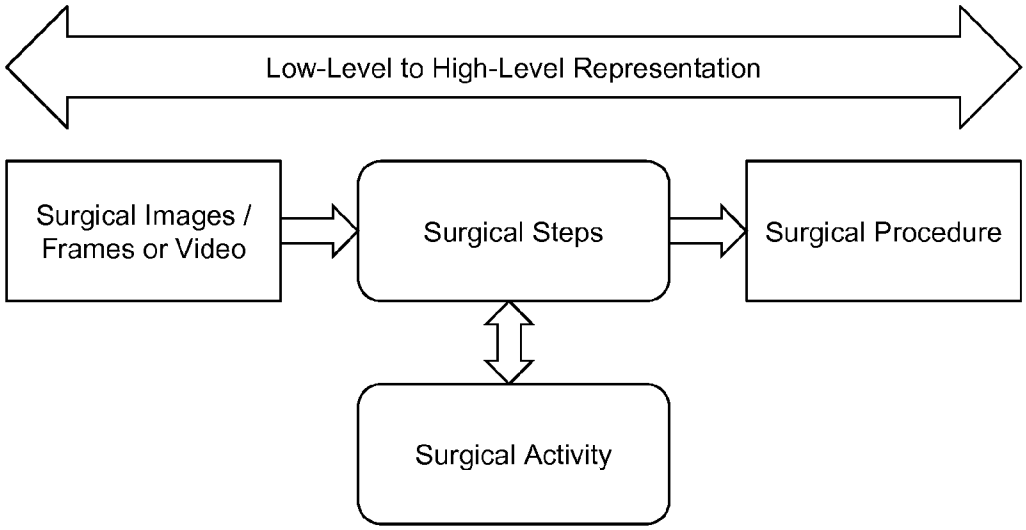
Low-Level to High-Level Representation
Surgical Images / Frames or Video
Surgical Steps
Surgical Procedure
Surgical Activity

Fig. 3

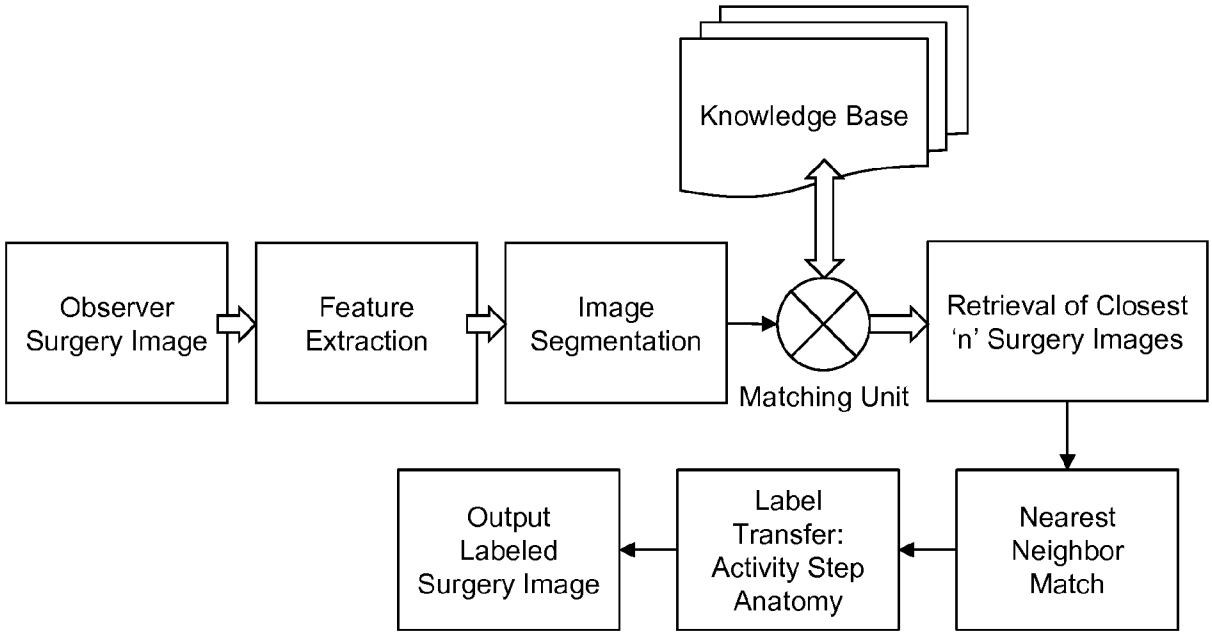
Knowledge Base
Observer Surgery Image
Feature Extraction
Image Segmentation
Matching Unit
Retrieval of Closest 'n' Surgery Images
Output Labeled Surgery Image
Label Transfer: Activity Step Anatomy
Nearest Neighbor Match

Fig. 4

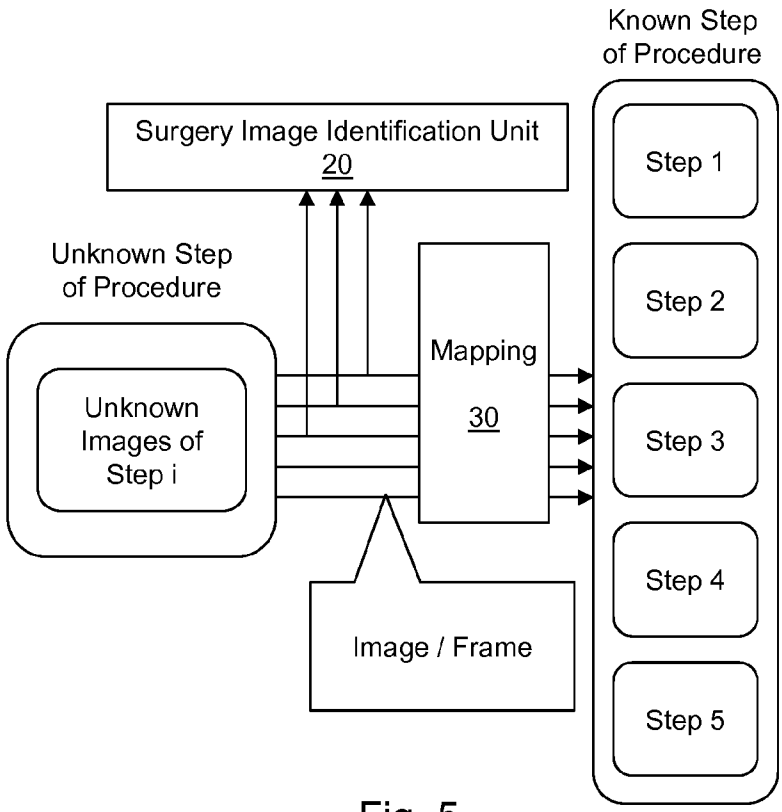
Known Step of Procedure
Surgery Image Identification Unit 20
Step 1
Step 2
Step 3
Step 4
Step 5
Unknown Step of Procedure
Unknown Images of Step i
Mapping 30
Image / Frame

Fig. 5

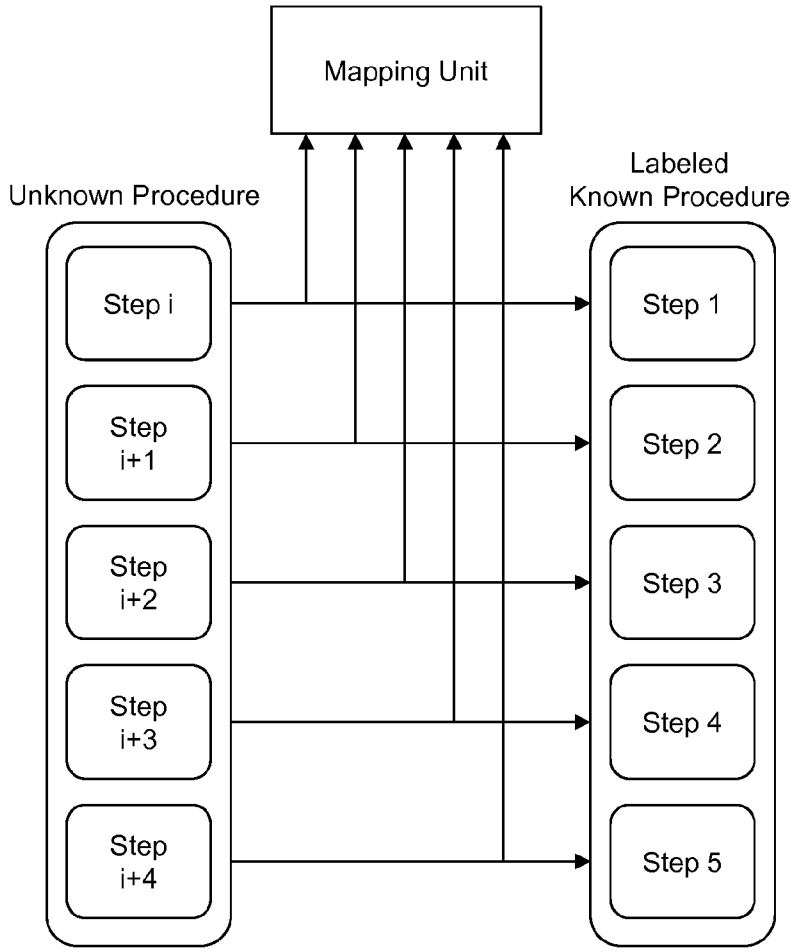
Mapping Unit
Unknown Procedure
Labeled
Known Procedure
Step i
Step
i+1
Step
i+2
Step
i+3
Step
i+4
Step 1
Step 2
Step 3
Step 4
Step 5

Fig. 6

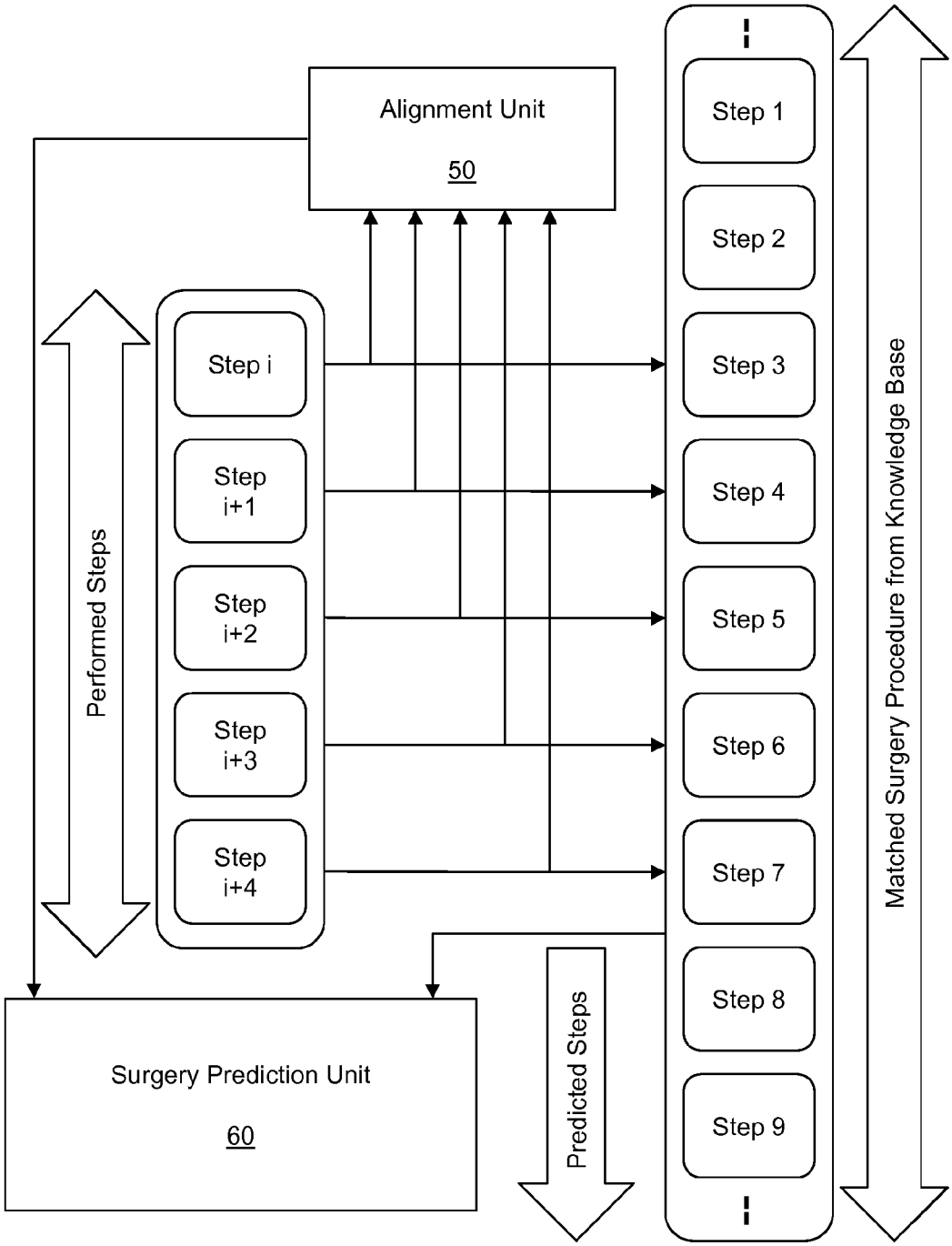
Alignment Unit
50
Step 1
Step 2
Step 3
Step 4
Step 5
Step 6
Step 7
Step 8
Step 9
Step i
Step i+1
Step i+2
Step i+3
Step i+4
Performed Steps
Matched Surgery Procedure from Knowledge Base
Predicted Steps
Surgery Prediction Unit
60

Fig. 7

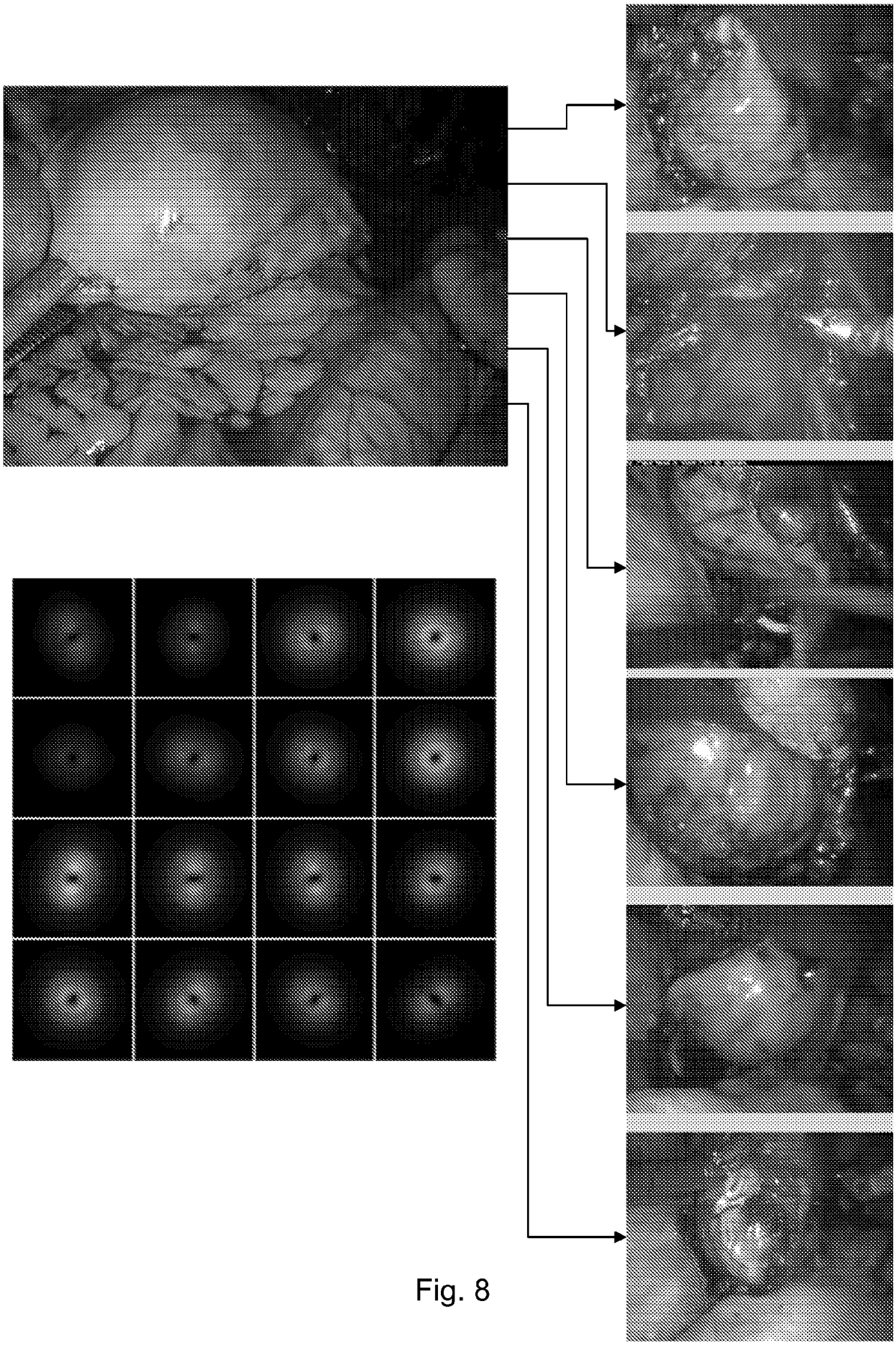

Fig. 8

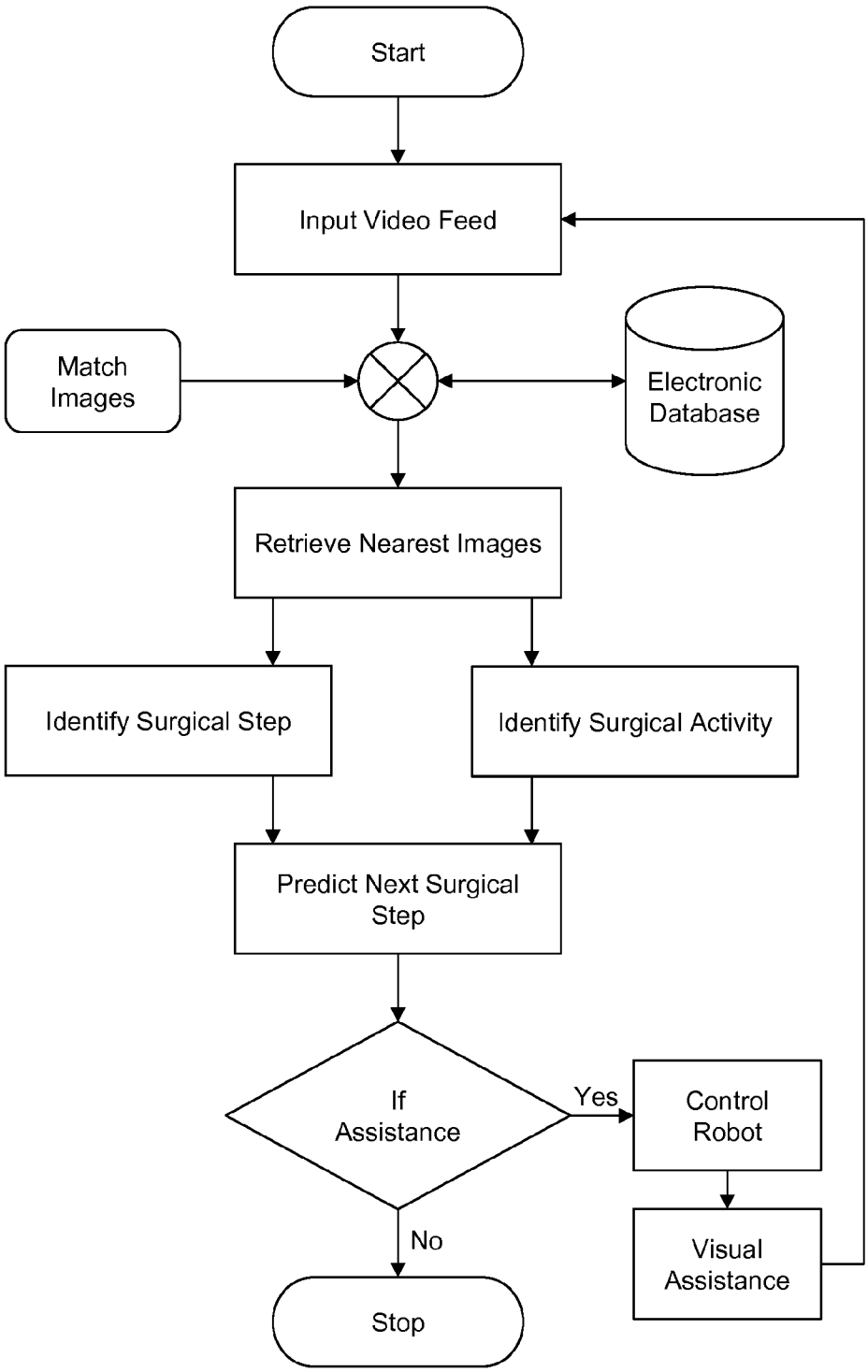
Start
Input Video Feed
Match Images
Electronic Database
Retrieve Nearest Images
Identify Surgical Step
Identify Surgical Activity
Predict Next Surgical Step
If Assistance
Yes
Control Robot
Visual Assistance
No
Stop

Fig. 9

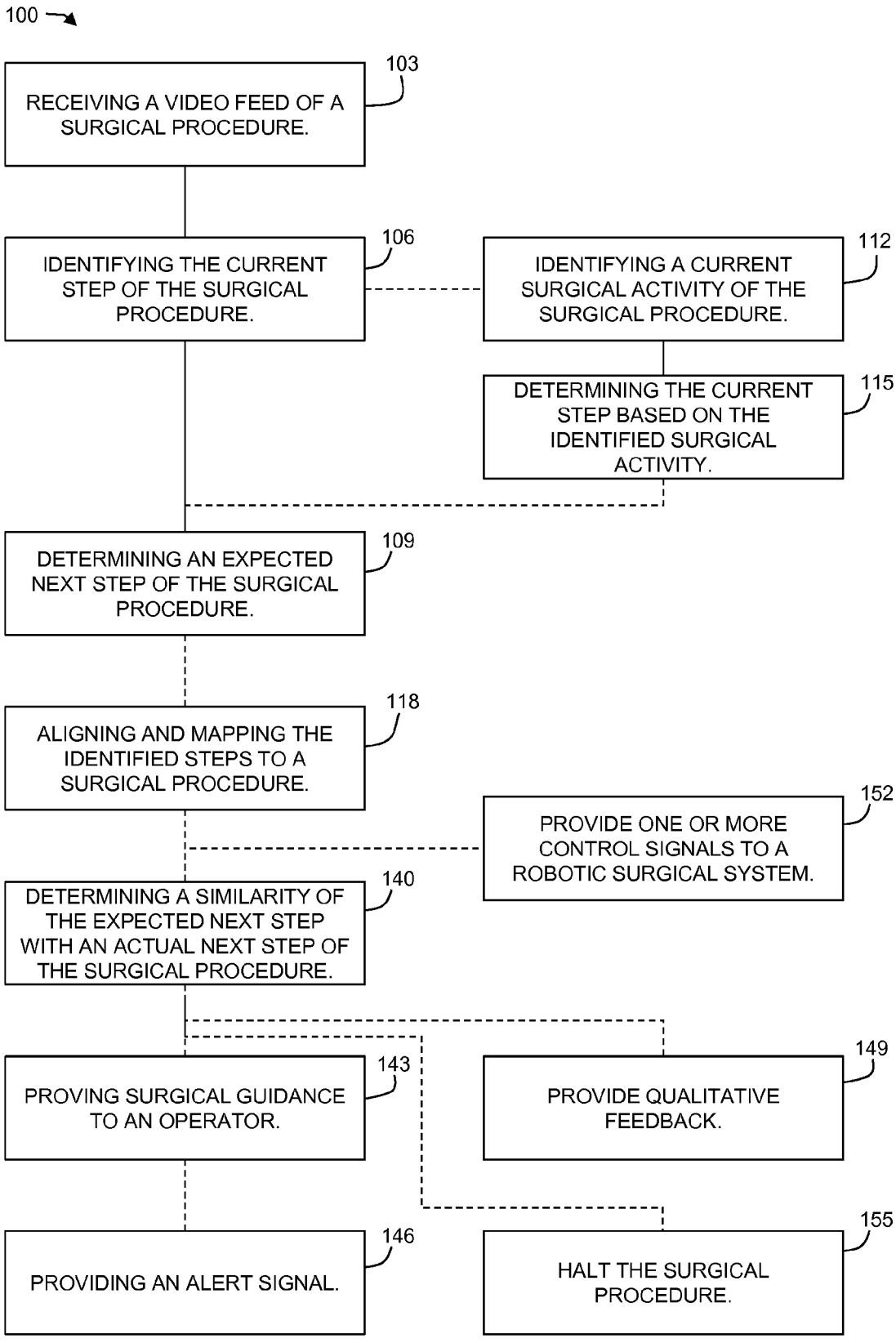
100
RECEIVING A VIDEO FEED OF A SURGICAL PROCEDURE.
103
IDENTIFYING THE CURRENT STEP OF THE SURGICAL PROCEDURE.
106
IDENTIFYING A CURRENT SURGICAL ACTIVITY OF THE SURGICAL PROCEDURE.
112
DETERMINING THE CURRENT STEP BASED ON THE IDENTIFIED SURGICAL ACTIVITY.
115
DETERMINING AN EXPECTED NEXT STEP OF THE SURGICAL PROCEDURE.
109
ALIGNING AND MAPPING THE IDENTIFIED STEPS TO A SURGICAL PROCEDURE.
118
PROVIDE ONE OR MORE CONTROL SIGNALS TO A ROBOTIC SURGICAL SYSTEM.
152
DETERMINING A SIMILARITY OF THE EXPECTED NEXT STEP WITH AN ACTUAL NEXT STEP OF THE SURGICAL PROCEDURE.
140
PROVING SURGICAL GUIDANCE TO AN OPERATOR.
143
PROVIDE QUALITATIVE FEEDBACK.
149
PROVIDING AN ALERT SIGNAL.
146
HALT THE SURGICAL PROCEDURE.
155

Fig. 10

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2014/063595

A. CLASSIFICATION OF SUBJECT MATTER
IPC(8) - G09B 5/00 (2014.01)
CPC - G06Q 50/22 (2014.11)
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)
IPC(8) - G09B 5/00, H04N 7/14, G06K 9/00 (2014.01)
USPC - 382/153, 600/117, 705/2

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
CPC - G06Q 50/22, A61B 19/2203, G06K 2209/057 (2014.11) (keyword delimited)

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

Orbit, Google Patents, Google.
Search terms used: predict, anticipate, expected, steps, frames, images, video feed, surgical procedures, guidance, database.

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2013/0093829 A1 (ROSENBLATT et al) 18 April 2013 (18.04.2013) entire document	1-2, 5-7, 11
Y		3-4, 8-10
Y	US 2012/0020547 A1 (ZHAO et al) 26 January 2012 (26.01.2012) entire document	3-4, 8-10
A	US 2012/0203067 A1 (HIGGINS et al) 09 August 2012 (09.08.2012) entire document	1-11
A	US 7,987,001 B2 (TEICHMAN et al) 26 July 2011 (26.06.2011) entire document	1-11

☐ 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	Date of mailing of the international search report
14 January 2015	09 FEB 2015
Name and mailing address of the ISA/US Mail Stop PCT, Attn: ISA/US, Commissioner for Patents P.O. Box 1450, Alexandria, Virginia 22313-1450 Facsimile No. 571-273-3201	Authorized officer: Blaine R. Copenheaver PCT Helpdesk: 571-272-4300 PCT OSP: 571-272-7774