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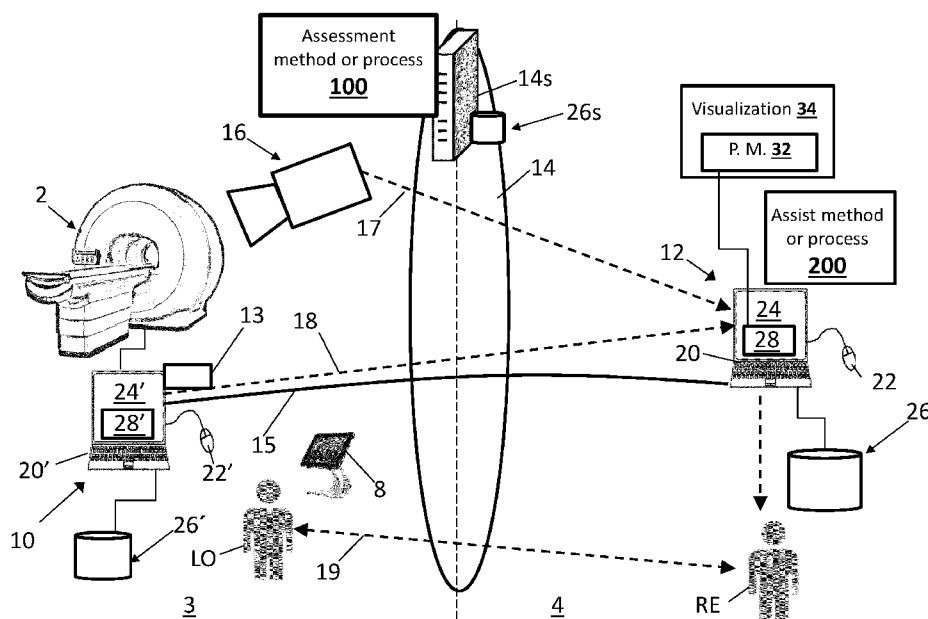


Figure 1

(57) Abstract: A method (100) of assessing performance of a local medical imaging device operator (LO) during imaging examinations performed using one or more medical imaging devices (2) includes: obtaining data related to the imaging examinations during performance of the medical imaging examinations; analyzing the obtained data to determine one or more performance metrics of the local operator; and during a current imaging examination, providing a remote assistance user interface (UI) (28) to at least one display device (24) operable by a remote expert (RE), the UI providing two-way communication between the local medical imaging device operator and the remote expert via which the remote expert can provide assistance to the local medical imaging device operator, the UI further displaying a visualization (34) of the determined one or more performance metrics of the local operator.

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TECHNOLOGIST ASSESSMENTS FOR PROFESSIONAL GROWTH AND OPERATIONAL IMPROVEMENT

[0001] The following relates generally to the imaging arts, remote imaging assistance arts, remote imaging examination monitoring arts, technology assessment arts, technologist development arts, and related arts.

BACKGROUND

[0002] Radiology operations command centers (ROCC) are a promising way for large imaging centers with pools of technologist (“tech”) talent to share tech expertise across an entire imaging network. By providing a communication channel (e.g. telephonic, videoconferencing, or so forth) and remote imaging device controller console sharing, an ROCC empowers the more experienced techs to provide guidance and oversight for junior techs when working with an imaging modality they may not be familiar or comfortable with. The quality of images acquired with ROCC assistance and the success achieved by use of an ROCC depends at least in part on how well the needs of the local techs are anticipated. However, assessing the knowledge and skills of individuals and evaluating their ability to perform the required tasks is difficult to do.

[0003] The following discloses certain improvements to overcome these problems and others.

SUMMARY

[0004] In one aspect, a non-transitory computer readable medium stores instructions executable by at least one electronic processor to perform a method of assessing performance of a local medical imaging device operator during imaging examinations performed using one or more medical imaging devices. The method includes: obtaining data related to the imaging examinations during performance of the medical imaging examinations; analyzing the obtained data to determine one or more performance metrics of the local operator; and during a current imaging examination, providing a remote assistance user interface (UI) to at least one display device operable by a remote expert, the UI providing two-way communication between the local medical imaging device operator and the remote expert via which the remote expert can provide assistance to the local medical imaging device operator, the UI further displaying a visualization of the determined one or more performance metrics of the local operator.

[0005] In another aspect, an apparatus for use in conjunction with a medical imaging device includes at least one electronic processor programmed to: receive images of an imaging examination performed by a local operator and audio or textual conversations between the local operator and a remote medical expert during the imaging examination; obtain data related to the imaging examinations during performance of the medical imaging examinations from the recorded images and recorded conversations; analyze the obtained data to determine one or more performance metrics of the local operator; and during a current imaging examination, provide a remote assistance user UI to at least one display device operable by a remote expert, the UI providing two-way communication between the local medical imaging device operator and the remote expert via which the remote expert can provide assistance to the local medical imaging device operator, the UI further displaying a visualization of the determined one or more performance metrics of the local operator.

[0006] In another aspect, a method of assessing performance of a local medical imaging device operator during imaging examinations performed using one or more medical imaging devices includes: screen-scraping data displayed on a display device of a medical imaging device controller of the medical imaging device; analyzing the screen-scraped data to determine one or more performance metrics of the local operator; and during a current imaging examination, providing a remote assistance UI to at least one display device operable by a remote expert, the UI providing two-way communication between the local medical imaging device operator and the remote expert via which the remote expert can provide assistance to the local medical imaging device operator, the UI further displaying a visualization of the determined one or more performance metrics of the local operator.

[0007] One advantage resides in automatically providing a remote expert or radiologist assisting a technician in conducting a medical imaging examination with information about the local technician.

[0008] Another advantage resides in assessing a technician's knowledge, skills, and limitations for medical examinations, and accordingly matching a remote expert with the technician.

[0009] Another advantage resides in tracking performance of a technician in performing imaging examinations, and tracking progress of the technician towards accreditation requirements.

[0010] A given embodiment may provide none, one, two, more, or all of the foregoing advantages, and/or may provide other advantages as will become apparent to one of ordinary skill in the art upon reading and understanding the present disclosure.

BRIEF DESCRIPTION OF THE DRAWINGS

[0011] The disclosure may take form in various components and arrangements of components, and in various steps and arrangements of steps. The drawings are only for purposes of illustrating the preferred embodiments and are not to be construed as limiting the disclosure.

[0012] FIGURE 1 diagrammatically shows an illustrative apparatus for providing remote assistance in accordance with the present disclosure.

[0013] FIGURE 2 shows an example flow chart of operations suitably performed by the apparatus of FIGURE 1.

[0014] FIGURE 3, 4, 5A, 5B, and 6 show examples of outputs generated by the apparatus of FIGURE 1.

DETAILED DESCRIPTION

[0015] The following relates to Radiology Operations Command Center (ROCC) systems and methods that provide remote expert or “supertech” assistance to a local technician performing an imaging examination. An ROCC collects information on the imaging examination being performed by the local technician, which is supplied to the supertech to enable the supertech to provide effective assistance. The provided information typically includes, for example, a copy of the imaging device controller display. It is recognized herein that this collected information can be leveraged for other purposes.

[0016] In some embodiments disclosed herein, a database is included that collects information on individual imaging examinations, including for example identification of the imaging technician (also referred to herein as the local technician), the imaging procedure, imaging modality and scanner used, date and duration of the imaging examination, the assigned Current Procedural Terminology (CPT) code, identification of whether expert assistance was utilized, an image quality assessment, patient feedback, various special notes (e.g., wheelchair-bound patient, infant or elderly patient, chronic conditions of the patient, etc.) and/or so forth.

[0017] Most of this information can be obtained by screen-scraping the image of the controller display acquired by the DVI splitter, software-based screen mirroring, or other screen-

sharing mechanism. Image quality assessment is further useful information, which optionally may be obtained from a radiologist self-assessment and/or automated image quality classification. Patient feedback still further useful information that is optionally obtained from post-examination surveys (for example, conducted via the Medumo cellphone app, available from Medumo, Cambridge, Massachusetts, USA).

[0018] With this information collected, various analyses of technician can be performed. For example, technologist expertise in various imaging procedures/modalities/vendors can be assessed statistically based on (for example) number of such imaging procedures the technologist has performed, exam durations (long durations may indicate the technician had difficulty with the exams), and the extent to which the technician relied upon the ROCC (more reliance may indicate low technician comfort with that type of imaging procedure). Technician performance can be analyzed longitudinally to see how rapidly the technician is improving.

[0019] Furthermore, the collected information can be used for diverse tasks such as providing a metric for determining technician advancement, identifying examinations needed to for accreditation, identifying optimal training areas for a given technician, and so forth.

[0020] A further use of the information is to generate technician summaries or profiles. These succinctly summarize the technician's experience in various types of imaging tasks as well as areas where the technician may be likely to need assistance. In the ROCC context, when an expert is called by a particular local technician, the summary or profile of that local technician may be displayed on the expert workstation so that the expert is quickly brought up to speed on the abilities and possible deficiencies of the local technician.

[0021] As yet another application, in some embodiments each imaging examination is recorded. This exam record includes a video of the scraped screen and a transcript or recording of any audio, videoconference, and/or chat box conversation that occurred between the local technician and the expert during the exam. These exam records can serve as ready-made training materials, e.g. if a particular local technician is determined to require training in some imaging procedure "X", then the database of exam records can be searched for the best examples of imaging procedure "X" as measured by quantitative metrics such as image quality, patient feedback, exam duration, and/or so forth.

[0022] With reference to FIGURE 1, an apparatus for providing assistance from a remote medical imaging expert **RE** (or supertech) to a local technician operator **LO** is shown. Such a

system is also referred to herein as a radiology operations command center (ROCC). As shown in FIGURE 1, the local operator **LO**, who operates a medical imaging device (also referred to as an image acquisition device, imaging device, and so forth) **2**, is located in a medical imaging device bay **3**, and the remote expert **RE** is disposed in a remote service location or center **4**. It should be noted that the remote expert **RE** may not necessarily directly operate the medical imaging device **2**, but rather provides assistance to the local operator **LO** in the form of advice, guidance, instructions, or the like. The remote location **4** can be a remote service center, a radiologist's office, a radiology department, and so forth. The remote location **4** may be in the same building as the medical imaging device bay **3** (this may, for example, in the case of a remote expert **RE** who is a radiologist tasked with peri-examination image review), or the remote service center **4** and the medical imaging device bay **3** may be in different buildings, and indeed may be located in different cities, different countries, and/or different continents. In general, the remote location **4** is remote from the imaging device bay **3** in the sense that the remote expert **RE** cannot directly visually observe the imaging device **2** in the imaging device bay **3** (hence optionally providing a video feed as described further herein).

[0023] The image acquisition device **2** can be a Magnetic Resonance (MR) image acquisition device, a Computed Tomography (CT) image acquisition device; a positron emission tomography (PET) image acquisition device; a single photon emission computed tomography (SPECT) image acquisition device; an X-ray image acquisition device; an ultrasound (US) image acquisition device; or a medical imaging device of another modality. The imaging device **2** may also be a hybrid imaging device such as a PET/CT or SPECT/CT imaging system. While a single image acquisition device **2** is shown by way of illustration in FIGURE 1, more typically a medical imaging laboratory will have multiple image acquisition devices, which may be of the same and/or different imaging modalities. For example, if a hospital performs many CT imaging examinations and relatively fewer MRI examinations and still fewer PET examinations, then the hospital's imaging laboratory (sometimes called the "radiology lab" or some other similar nomenclature) may have three CT scanners, two MRI scanners, and only a single PET scanner. This is merely an example. Moreover, the remote service center **4** may provide service to multiple hospitals. The local operator **LO** controls the medical imaging device **2** via an imaging device controller **10**. The remote expert **RE** is stationed at a remote workstation **12** (or, more generally, an electronic controller **12**).

[0024] As used herein, the term “medical imaging device bay” (and variants thereof) refer to a room containing the medical imaging device **2** and also any adjacent control room containing the medical imaging device controller **10** for controlling the medical imaging device. For example, in reference to an MRI device, the medical imaging device bay **3** can include the radiofrequency (RF) shielded room containing the MRI device **2**, as well as an adjacent control room housing the medical imaging device controller **10**, as understood in the art of MRI devices and procedures. On the other hand, for other imaging modalities such as CT, the imaging device controller **10** may be located in the same room as the imaging device **2**, so that there is no adjacent control room and the medical bay **3** is only the room containing the medical imaging device **2**. The imaging device controller **10** includes an electronic processor **20'**, at least one user input device such as a mouse **22'**, a keyboard, and/or so forth, and a display device **24'**. The imaging device controller **10** presents a device controller graphical user interface (GUI) **28'** on the display **24'** of the imaging device controller **10**, via which the local operator **LO** accesses device controller GUI screens for entering the imaging examination information such as the name of the local operator **LO**, the name of the patient and other relevant patient information (e.g. gender, age, etc.) and for controlling the (typically robotic) patient support to load the patient into the bore or imaging examination region of the imaging device **2**, selecting and configuring the imaging sequence(s) to be performed, acquiring preview scans to verify positioning of the patient, executing the selected and configured imaging sequences to acquire clinical images, display the acquired clinical images for review, and ultimately store the final clinical images to a Picture Archiving and Communication System (PACS) or other imaging examinations database. In addition, while FIGURE 1 shows a single medical imaging device bay **3**, it will be appreciated that the remote service center **4** (and more particularly the remote workstation **12**) is in communication with multiple medical bays via a communication link **14**, which typically comprises the Internet augmented by local area networks at the remote operator **RE** and local operator **LO** ends for electronic data communications.

[0025] As diagrammatically shown in FIGURE 1, in some embodiments, a camera **16** (e.g., a video camera) is arranged to acquire a video stream **17** of a portion of the medical imaging device bay **3** that includes at least the area of the imaging device **2** where the local operator **LO** interacts with the patient, and optionally may further include the imaging device controller **10**. The video stream **17** is sent to the remote workstation **12** via the communication link **14**, e.g. as a streaming

video feed received via a secure Internet link. In some examples, as shown in FIGURE 1, the camera **16** can be affixed to a wall of ceiling of the medical facility with a field of view to include the area of the imaging device **2** where the local operator **LO** interacts with the patient, and optionally may further include the imaging device controller **10**. In other examples, the camera **16** can be disposed within an imaging bore (not shown) of the imaging device **2**.

[0026] In other embodiments, the live video feed **17** of the display **24'** of the imaging device controller **10** is, in the illustrative embodiment, provided by a video cable splitter **15** (e.g., a DVI splitter, a HDMI splitter, and so forth). In other embodiments, the live video feed **17** may be provided by a video cable connecting an auxiliary video output (e.g. aux vid out) port of the imaging device controller **10** to the remote workstation **12** of the operated by the remote expert **RE**. Alternatively, a screen mirroring data stream **18** is generated by screen sharing software **13** running on the imaging device controller **10** which captures a real-time copy of the display **24'** of the imaging device controller **10**, and this copy is sent from the imaging device controller **10** to the remote workstation **12**. Other approaches besides the illustrative video cable splitter **15** or screen sharing software **13** are contemplated for capturing a real-time copy of the display **24'** of the imaging device controller **10** which is then sent to the workstation **12** of the remote expert **RE**. While in an ROCC this real-time copy of the display **24'** of the imaging device controller **10** is used to provide status information to the remote expert **RE** for use in assisting the local operator **LO**, in embodiments disclosed herein the real-time copy of the display **24'** of the imaging device controller **10** is also leveraged (optionally along with other available information) to determine one or more performance metrics of the local operator **LO**.

[0027] The communication link **14** also provides a natural language communication pathway **19** for verbal and/or textual communication between the local operator **LO** and the remote expert **RE**, in order to enable the latter to assist the former in performing the imaging examination. For example, the natural language communication link **19** may be a Voice-Over-Internet-Protocol (VOIP) telephonic connection, a videoconferencing service, an online video chat link, a computerized instant messaging service, or so forth. Alternatively, the natural language communication pathway **19** may be provided by a dedicated communication link that is separate from the communication link **14** providing the data communications **17**, **18**, e.g. the natural language communication pathway **19** may be provided via a landline telephone. In another example, the natural language communication pathway **19** may be provided via an ROCC device

8, such as a mobile device (e.g., a tablet computer or a smartphone). For example, an “app” can run on the ROCC device **8** (operable by the local operator **LO**) and the remote workstation **12** (operable by the remote expert **RE**) to allow communication (e.g., audio chats, video chats, and so forth) between the local operator and the remote expert.

[0028] FIGURE 1 also shows, in the remote service center **4** including the remote workstation **12**, such as an electronic processing device, a workstation computer, or more generally a computer, which is operatively connected to receive and present the video **17** of the medical imaging device bay **3** from the camera **16** and to present the screen mirroring data stream **18** as a mirrored screen. Additionally or alternatively, the remote workstation **12** can be embodied as a server computer or a plurality of server computers, e.g. interconnected to form a server cluster, cloud computing resource, or so forth. The workstation **12** includes typical components, such as an electronic processor **20** (e.g., a microprocessor), at least one user input device (e.g., a mouse, a keyboard, a trackball, and/or the like) **22**, and at least one display device **24** (e.g. an LCD display, plasma display, cathode ray tube display, and/or so forth). In some embodiments, the display device **24** can be a separate component from the workstation **12**. The display device **24** may also comprise two or more display devices, e.g. one display presenting the video **17** and the other display presenting the shared screen (i.e. display **24'**) of the imaging device controller **10** generated from the screen mirroring data stream **18**. Alternatively, the video and the shared screen may be presented on a single display in respective windows. The electronic processor **20** is operatively connected with a one or more non-transitory storage media **26**. The non-transitory storage media **26** may, by way of non-limiting illustrative example, include one or more of a magnetic disk, RAID, or other magnetic storage medium; a solid state drive, flash drive, electronically erasable read-only memory (EEROM) or other electronic memory; an optical disk or other optical storage; various combinations thereof; or so forth; and may be for example a network storage, an internal hard drive of the workstation **12**, various combinations thereof, or so forth. It is to be understood that any reference to a non-transitory medium or media **26** herein is to be broadly construed as encompassing a single medium or multiple media of the same or different types. Likewise, the electronic processor **20** may be embodied as a single electronic processor or as two or more electronic processors. The non-transitory storage media **26** stores instructions executable by the at least one electronic processor **20**. The instructions include instructions to generate a graphical user interface (GUI) **28** for display on the remote operator display device **24**.

[0029] The medical imaging device controller **10** in the medical imaging device bay **3** also includes similar components as the remote workstation **12** disposed in the remote service center **4**. Except as otherwise indicated herein, features of the medical imaging device controller **10** disposed in the medical imaging device bay **3** similar to those of the remote workstation **12** disposed in the remote service center **4** have a common reference number followed by a “prime” symbol (e.g., processor **20'**, display **24'**, GUI **28'**) as already described. In particular, the medical imaging device controller **10** is configured to display the imaging device controller GUI **28'** on a display device or controller display **24'** that presents information pertaining to the control of the medical imaging device **2** as already described, such as imaging acquisition monitoring information, presentation of acquired medical images, and so forth. It will be appreciated that the real-time copy of the display **24'** of the controller **10** provided by the video cable splitter **15** or the screen mirroring data stream **18** carries the content presented on the display device **24'** of the medical imaging device controller **10**. The communication link **14** allows for screen sharing from the display device **24'** in the medical imaging device bay **3** to the display device **24** in the remote service center **4**. The GUI **28'** includes one or more dialog screens, including, for example, an examination/scan selection dialog screen, a scan settings dialog screen, an acquisition monitoring dialog screen, among others. The GUI **28'** can be included in the video feed **17** or provided by the video cable splitter **15** or by the mirroring data stream **17'** and displayed on the remote workstation display **24** at the remote location **4**.

[0030] FIGURE 1 shows an illustrative local operator **LO**, and an illustrative remote expert **RE** (i.e. expert, e.g. supertech). However, the ROCC optionally provides a staff of supertechs who are available to assist local operators **LO** at different hospitals, radiology labs, or the like. The ROCC may be housed in a single physical location or may be geographically distributed. For example, in one contemplated implementation, the remote operators **RO** are recruited from across the United States and/or internationally in order to provide a staff of supertechs with a wide range of expertise in various imaging modalities and in various imaging procedures targeting various imaged anatomies. In view of this multiplicity of local operators **LO** and multiplicity of remote operators **RO**, the disclosed communication link **14** includes a server computer **14s** (or a cluster of servers, cloud computing resource comprising servers, or so forth) which is programmed to establish connections between selected local operator **LO**/remote expert **RE** pairs. For example, if the server computer **14s** is Internet-based, then connecting a specific

selected local operator **LO**/remote expert **RE** pair can be done using Internet Protocol (IP) addresses of the various components **16**, **10**, **12**, the telephonic or video terminals of the natural language communication pathway **19**, et cetera. The server computer **14s** is operatively connected with a one or more non-transitory storage media **26s**. The non-transitory storage media **26s** may, by way of non-limiting illustrative example, include one or more of a magnetic disk, RAID, or other magnetic storage medium; a solid state drive, flash drive, electronically erasable read-only memory (EEROM) or other electronic memory; an optical disk or other optical storage; various combinations thereof; or so forth; and may be for example a network storage, an internal hard drive of the server computer **14s**, various combinations thereof, or so forth. It is to be understood that any reference to a non-transitory medium or media **26s** herein is to be broadly construed as encompassing a single medium or multiple media of the same or different types. Likewise, the server computer **14s** may be embodied as a single electronic processor or as two or more electronic processors. The non-transitory storage media **26s** stores instructions executable by the server computer **14s**. In addition, the non-transitory computer readable medium **26s** (or another database) stores data related to a set of remote experts **RE** and/or a set of local operators **LO**. The remote expert data can include, for example, skill set data, work experience data, data related to ability to work on multi-vendor modalities, data related to experience with the local operator **LO** and so forth.

[0031] Furthermore, as disclosed herein the server **14s** performs a method or process **100** for assessing performance of a local medical imaging device operator **LO** during imaging examinations performed using one or more of the medical imaging devices **2**. The assessment method **100** advantageously leverages information sources provided by the ROCC, such as the content of the display **24'** of the imaging device controller display

[0032] The server computer **14s** can also store data related to relevant information acquired during each imaging examination performed by a local operator **LO**. The stored data can include, for example, a vendor and modality of the medical imaging device **2** used in the imaging examination, an identification of the local medical imaging device operator **LO**, a modality of the medical imaging device an identification of the medical imaging device, an assigned current procedural terminology code, an identification of whether assistance from a remote medical expert was used, communication notes between the local operator and the remote medical expert, patient data (e.g., frail individuals, pediatric exams, disabled individuals, and so forth), a duration of the

imaging examination, sequences repeated during the imaging examination, quality of images acquired during the imaging examination, notes regarding adversary events (e.g., device malfunction), and so forth.

[0033] With reference to FIGURE 2, and with continuing reference to FIGURE 1, an illustrative embodiment of the technician assessment method **100** is diagrammatically shown as a flowchart. At an operation **102**, data related to the imaging examinations is obtained during performance of the medical imaging examinations. In one example, the obtaining operation **102** includes screen-scraping data displayed on the display device **24'** of the medical imaging device controller **10** of the medical imaging device **2**. This screen-scraping leverages the availability of the real-time copy of the display **24'** of the imaging device controller **10** provided by the video cable splitter **15** or the screen sharing software **13**. The screen scraping can use any suitable approach for extracting relevant information from the real-time copy of the display **24'** of the imaging device controller **10**. For example, video frames can be analyzed by optical character recognition (OCR) to extract text. As the imaging device controller GUI **28'** typically uses standardized dialog screens, the screen scraping can leverage *a priori* knowledge about the layouts of these dialog screens to enable more precise information extraction. For example, if a dialog screen has one input area for entry of the local operator **LO** identification and another input area for entry of the patient identification, then this *a priori* knowledge of the layout can be used to distinguish the local operator and patient names. Similarly, specific dialog screens may be brought up for specific imaging sequences, and recognition of these specific dialog screens in the real-time copy of the display **24'** of the imaging device controller **10** enables extraction of the selected imaging sequence, and *a priori* knowledge of the layouts of these dialog screens can be used to correlate numeric or other inputs to specific scan parameters. These are merely some non-limiting illustrative examples of information extraction approaches suitably used in the screen-scraping. The data displayed on the display device **24'** of a medical imaging device controller **10** typically includes information useful to the technician assessment method **100** such as an identification of the local medical imaging device operator **LO**, a modality of the medical imaging device **2**, an identification of the medical imaging device, an assigned current procedural terminology code, an identification of whether assistance from a remote medical expert was used, and patient data.

[0034] In another example, the obtaining operation **102** includes recording images of an imaging examination performed by the local operator **LO** with the camera **16**, and recording audio

or textual conversations between the local operator and the remote medical expert during the imaging examination via the natural language communication pathway **19**. The data can then be obtained from the recorded images and recorded conversations. The obtained data can also be stored in the server computer **14s**.

[0035] The foregoing examination data gathering operation **102** is suitably performed each time the local operator **LO** performs an imaging examination with the ROCC in operation. In some embodiments, the ROCC operation is modified to generate the real-time copy of the display **24'** of the controller **10** provided by the video cable splitter **15** or the screen mirroring data stream **18** throughout each examination, even if the local operator **LO** does not utilize assistance of a remote expert via the ROCC. In this way, the existing hardware of the ROCC (e.g., the video cable splitter **15** or the screen mirroring software **13**) is leveraged to ensure that examination data collection occurs for all examinations, regardless of whether and for how long the ROCC is utilized. The examination data collected over days, weeks, months, or longer are suitably collected to provide a sizable database of examination data for the local operator **LO** that may include many dozens, hundreds, or more imaging examinations performed by the local operator **LO**.

[0036] At an operation **104**, this sizable database of examination data for the local operator **LO** collected using the ROCC infrastructure is analyzed to determine one or more performance metrics **32** of the local operator **LO**. In one example embodiment, the obtained data can be statistically assessed based on one or more of, for example, for the imaging examinations the local operator has performed, durations of imaging procedures the local operator has performed, an extent which the local operator accessed the GUI **28** for assistance to perform the imaging procedures, and so forth. From this analysis, the one or more performance metrics **32** can be determined, and can include, for example, a performance metric for determining advancement of the local operator **LO**, a performance metric for determining optimal imaging tasks to assign to the local operator, a performance metric for identifying imaging examinations needed for accreditation for the local operator, among others.

[0037] At an operation **106**, during a current imaging examination, the GUI **28** is provided as a remote assistance UI on the display device **24** operable by a remote expert **RE**. The UI **28** provides two-way communication between the local operator **LO** and the remote expert **RE** via which the remote expert can provide assistance to the local medical imaging device operator. The UI **28** further displays a visualization **34** of the determined one or more performance metrics **32**

of the local operator **LO**. The visualization **34** is representative of a profile summarizing performance of the local operator **LO** in performing the imaging examinations.

[0038] FIGURES 3, 4, 5, 5A, 5B, and 6 show examples the visualization **34**. FIGURE 3 shows an example of the data stored in the training database **31**. FIGURE 4 shows the visualization **34** including the performance metrics **32**. A first performance metric **32** can include a “performance” icon **36** that includes a single local operator’s **LO** performance for specific imaging examinations, or the performance of multiple local operators for a specific type of examination. This performance metric can include an option of identifying imaging examinations with poor patient feedback, extended procedure durations, and so forth for further analysis. A second performance metric **32** can include an “indicators” icon **38** that includes key performance indicators (KPIs) indicative of performance of a specific local operator **LO** compared to other, similar local operators. This performance metric **32** can be used to identify local operators **LO** for advancement (i.e., from junior tech to senior tech).

[0039] A third performance metric **32** can include a “growth” icon **40** including analytics of local operator **LO** performance over a selected time duration (e.g., six months, twelve months, etc.) to show improvements and identify areas that require further attention for particular local operator. A fourth performance metric **32** can include a “goals” icon **42** for setting goals for local operators **LO** based on their performance (i.e. improving proficiency in breast imaging, start scanning pediatric patients, work toward shortening procedure durations for Musculo-Skeletal (MSK) scans). Training opportunities can be identified based on the performance and goals of individual local operators **LO**.

[0040] FIGURES 5A and 5B shows two more examples of the visualization **34**. In a first example (FIGURE 5A), a circle chart is shown with statistics on various types of imaging examinations performed by local operators **LO**. In a second example (FIGURE 5B), a Venn diagram is shown based on types of examinations (in which the “largest circle” corresponds to the top rectangle in the key, the second-largest circle corresponds to the “second” rectangle in the key, and so forth).

[0041] FIGURE 6 shows an example of the visualization **34** of an individual local operator **LO**. A drop-down menu **46** listing a set of experience metrics **48** of the local operator **LO** can be shown. As shown in FIGURE 6, the set of experience metrics **48** can include a brain imaging experience metric, a spine imaging experience metric, a liver imaging experience metric, a heart

imaging experience metric, and a knee imaging experience metric. For instance, if a local operator **LO** has been noted to struggle in acquiring spine imaging (e.g., MRI) examinations on a medical imaging device **2** manufactured by Siemens scanner, a session demonstrating a past successful acquisition of the exact exam in question can be readily arranged.

[0042] FIGURE 6 also shows a menu **44** showing a profile of the local operator **LO**, a description of the local operator's qualifications, and areas the local operator needs to improve on during imaging examinations. As an example, clinical experience requirements for MRI can include conducting 53 procedures in 7 different categories (e.g., head and neck, spine, thorax, abdomen and pelvis, msk, special imaging procedures, quality control). There are rules about the number of repetitions for different procedures (i.e., at least 125 repetitions across all procedures) and further nuances for different credential options. The apparatus **10** help techs and their managers to keep track of where they are in the accreditation process and make suggestions regarding upcoming scans matching technologist needs to complete the requirements within the predefined time window.

[0043] Referring back to FIGURE 1, the communication link **14** connects the local operator **LO**/ remote expert **RE**. The remote workstation **12** of the selected remote expert **RE**, and/or the medical imaging device controller **10** being run by the local operator **LO**, is configured to perform a method or process **200** for providing assistance from the remote expert **RE** to the local operator **LO**. For brevity, the method **200** will be described as being performed by the remote workstation **12**. The non-transitory storage medium **26** stores instructions which are readable and executable by the at least one electronic processor **20** (of the workstation **12**, as shown, and/or the electronic processor or processors of a server or servers on a local area network or the Internet) to perform disclosed operations including performing the method or process **200**.

[0044] A suitable implementation of the assistance method or process **200** is as follows. The method **200** is performed over the course of (at least a portion of) a medical imaging examination performed using the medical imaging device **2**, and the local expert **RE** is one selected via the matching method **100**. As used herein, the term "duration of a medical imaging examination" (or variants thereof) refers to a time period of a medical imaging examination that includes (i) an actual image acquisition time, (ii) imaging follow-on processing time, and (iii) up to a time of patient release. To perform the method **200**, the workstation **12** in the remote location **4** is programmed to receive at least one of: (i) the video **17** from the video camera **16** of

the medical imaging device **2** located in the medical imaging device bay **3**; and/or (ii) the screen sharing **18** from the screen sharing software **13**; and/or (iii) the video **17** tapped by the video cable splitter **15**. The video feed **17** and/or the screen sharing **18** can be displayed at the remote workstation display **24**, typically in separate windows of the GUI **28**. The video feed **17** and/or the screen sharing **18** can be screen-scraped to determine information related to the medical imaging examination (e.g., modality, vendor, anatomy to be imaged, cause of issue to be resolved, and so forth). In particular, the GUI **28** presented on the display **24** of the remote workstation **12** preferably includes a window presenting the video **17**, and a window presenting the mirrored screen of the medical imaging device controller **10** constructed from the screen mirroring data stream **18**, and status information on the medical imaging examination that is maintained at least in part using the screen-scraped information. This allows the remote operator **RE** to be aware of the content of the display of the medical imaging device controller **10** (via the shared screen) and also to be aware of the physical situation, e.g. position of the patient in the medical imaging device **2** (via the video **17**), and to additionally be aware of the status of the imaging examination as summarized by the status information. During an imaging procedure, the natural language communication pathway **19** is suitably used to allow the local operator **LO** and the remote operator **RE** to discuss the procedure and in particular to allow the remote operator to provide advice to the local operator.

[0045] The disclosure has been described with reference to the preferred embodiments. Modifications and alterations may occur to others upon reading and understanding the preceding detailed description. It is intended that the exemplary embodiment be construed as including all such modifications and alterations insofar as they come within the scope of the appended claims or the equivalents thereof.

CLAIMS:

1. A non-transitory computer readable medium (**26s**) storing instructions executable by at least one electronic processor (**14s**) to perform a method (**100**) of assessing performance of a local medical imaging device operator (**LO**) during imaging examinations performed using one or more medical imaging devices (**2**), the method comprising:

obtaining data related to the imaging examinations during performance of the medical imaging examinations;

analyzing the obtained data to determine one or more performance metrics of the local operator; and

during a current imaging examination, providing a remote assistance user interface (UI) (**28**) to at least one display device (**24**) operable by a remote expert (**RE**), the UI providing two-way communication between the local medical imaging device operator and the remote expert via which the remote expert can provide assistance to the local medical imaging device operator, the UI further displaying a visualization (**34**) of the determined one or more performance metrics of the local operator.

2. The non-transitory computer readable medium (**26s**) of claim 1, wherein obtaining data related to the imaging examination includes:

screen-scraping data displayed on a display device (**24'**) of a medical imaging device controller (**10**) of the medical imaging device (**2**).

3. The non-transitory computer readable medium (**26s**) of claim 2, wherein the data displayed on the display device (**24'**) of a medical imaging device controller (**10**) includes an identification of the local medical imaging device operator (**LO**), a modality of the medical imaging device (**2**), an identification of the medical imaging device, an assigned current procedural terminology code, an identification of whether assistance from a remote medical expert was used, and patient data.

4. The non-transitory computer readable medium (**26s**) of claim 3, wherein analyzing the obtained data to determine one or more performance metrics of the local operator (**LO**) includes:

statistically assessing the obtained data for the imaging examinations the local operator has performed.

5. The non-transitory computer readable medium (**26s**) of either one of claims 3 and 4, wherein analyzing the obtained data to determine one or more performance metrics of the local operator (**LO**) includes:

statistically assessing the obtained data based on durations of imaging procedures the local operator has performed.

6. The non-transitory computer readable medium (**26s**) of any one of claims 3-5, wherein analyzing the obtained data to determine one or more performance metrics of the local operator (**LO**) includes:

statistically assessing the obtained data based on an extent which the local operator accessed the remote assistance UI (**28**) for assistance to perform the imaging procedures.

7. The non-transitory computer readable medium (**26s**) of any one of claims 1-6, wherein analyzing the obtained data to determine one or more performance metrics of the local operator (**LO**) includes:

from the analyzing, determining a performance metric for determining advancement of the local operator.

8. The non-transitory computer readable medium (**26s**) of any one of claims 1-7, wherein analyzing the obtained data to determine one or more performance metrics of the local operator (**LO**) includes:

from the analyzing, determining a performance metric for determining optimal imaging tasks to assign to the local operator.

9. The non-transitory computer readable medium (**26s**) of any one of claims 1-8, wherein analyzing the obtained data to determine one or more performance metrics of the local operator

(LO) includes:

from the analyzing, determining a performance metric for identifying imaging examinations needed for accreditation for the local operator.

10. The non-transitory computer readable medium (26s) of any one of claims 1-9, wherein the visualization (34) is representative of a profile summarizing performance of the local operator (LO) in performing the imaging examinations.

11. The non-transitory computer readable medium (26s) of any one of claims 1-10, wherein the method (100) further includes:

recording images of an imaging examination performed by the local operator (LO);
recording audio or textual conversations between the local operator and a remote medical expert during the imaging examination; and
obtaining the data from the recorded images and recorded conversations.

12. The non-transitory computer readable medium (26s) of claim 11, wherein the method (100) further includes:

storing the obtained data in a training database (14s).

13. An apparatus (10) for use in conjunction with a medical imaging device (2), the apparatus including at least one electronic processor (14s) programmed to:

receive images of an imaging examination performed by a local operator (LO) and audio or textual conversations between the local operator and a remote medical expert during the imaging examination;

obtain data related to the imaging examinations during performance of the medical imaging examinations from the recorded images and recorded conversations;

analyze the obtained data to determine one or more performance metrics of the local operator; and

during a current imaging examination, provide a remote assistance user interface (UI) (28) to at least one display device (24) operable by a remote expert (RE), the UI providing two-way communication between the local medical imaging device operator and the remote expert

via which the remote expert can provide assistance to the local medical imaging device operator, the UI further displaying a visualization (34) of the determined one or more performance metrics of the local operator.

14. The apparatus (10) of claim 13, wherein the at least one electronic processor (14s) is programmed to:

screen-scrape data displayed on a display device (24') of a medical imaging device controller (10) of the medical imaging device (2).

15. The apparatus (10) of claim 14, wherein the data displayed on the display device (24') of a medical imaging device controller (10) includes an identification of the local medical imaging device operator (LO), a modality of the medical imaging device (2), an identification of the medical imaging device, an assigned current procedural terminology code, an identification of whether assistance from a remote medical expert was used, and patient data.

16. The apparatus (10) of claim 15, wherein the at least one electronic processor (14s) is programmed to statistically assess the obtained data for the imaging examinations the local operator has performed based on one or more of durations of imaging procedures the local operator has performed and an extent which the local operator accessed the remote assistance UI (28) for assistance to perform the imaging procedures.

17. The apparatus (10) of any one of claims 13-16, wherein the at least one electronic processor (14s) is programmed to determining one or more performance metrics including a performance metric for determining advancement of the local operator, a performance metric for determining optimal imaging tasks to assign to the local operator, and a performance metric for identifying imaging examinations needed for accreditation for the local operator.

18. The apparatus (10) of any one of claims 13-17, wherein the visualization (34) is representative of a profile summarizing performance of the local operator (LO) in performing the imaging examinations.

19. The apparatus (10) of any one of claims 13-18, further including:

a video cable splitter (15) operatively connected with an imaging device controller (10) of the medical imaging device (2) via which the at least one electronic processor (14s) receives the data displayed on the imaging device controller.

20. A method (100) of assessing performance of a local medical imaging device operator (LO) during imaging examinations performed using one or more medical imaging devices (2), the method comprising:

screen-scraping data displayed on a display device (24') of a medical imaging device controller (10) of the medical imaging device (2);

analyzing the screen-scraped data to determine one or more performance metrics of the local operator; and

during a current imaging examination, providing a remote assistance user interface (UI) (28) to at least one display device (24) operable by a remote expert (RE), the UI providing two-way communication between the local medical imaging device operator and the remote expert via which the remote expert can provide assistance to the local medical imaging device operator, the UI further displaying a visualization (34) of the determined one or more performance metrics of the local operator.

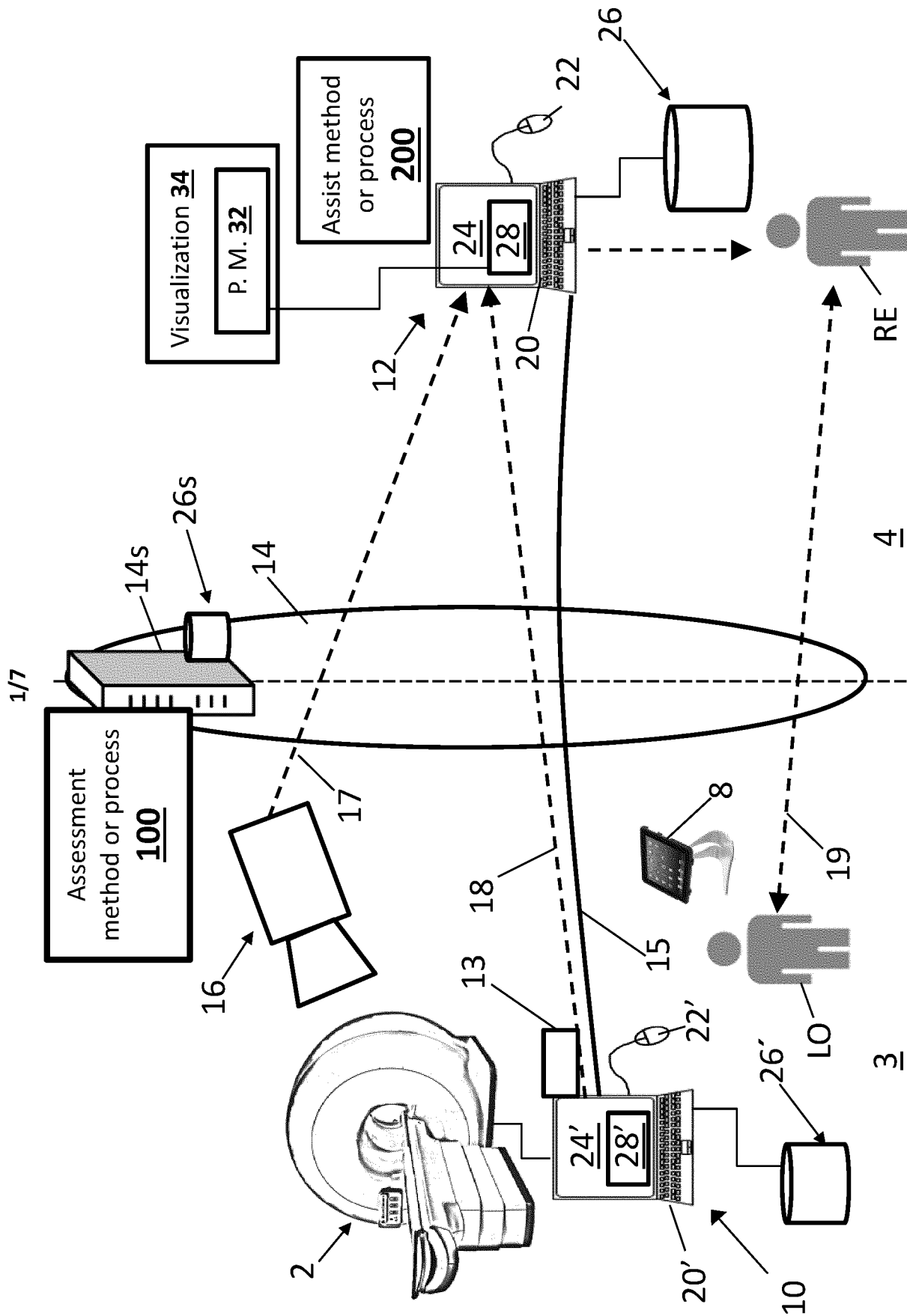


Figure 1

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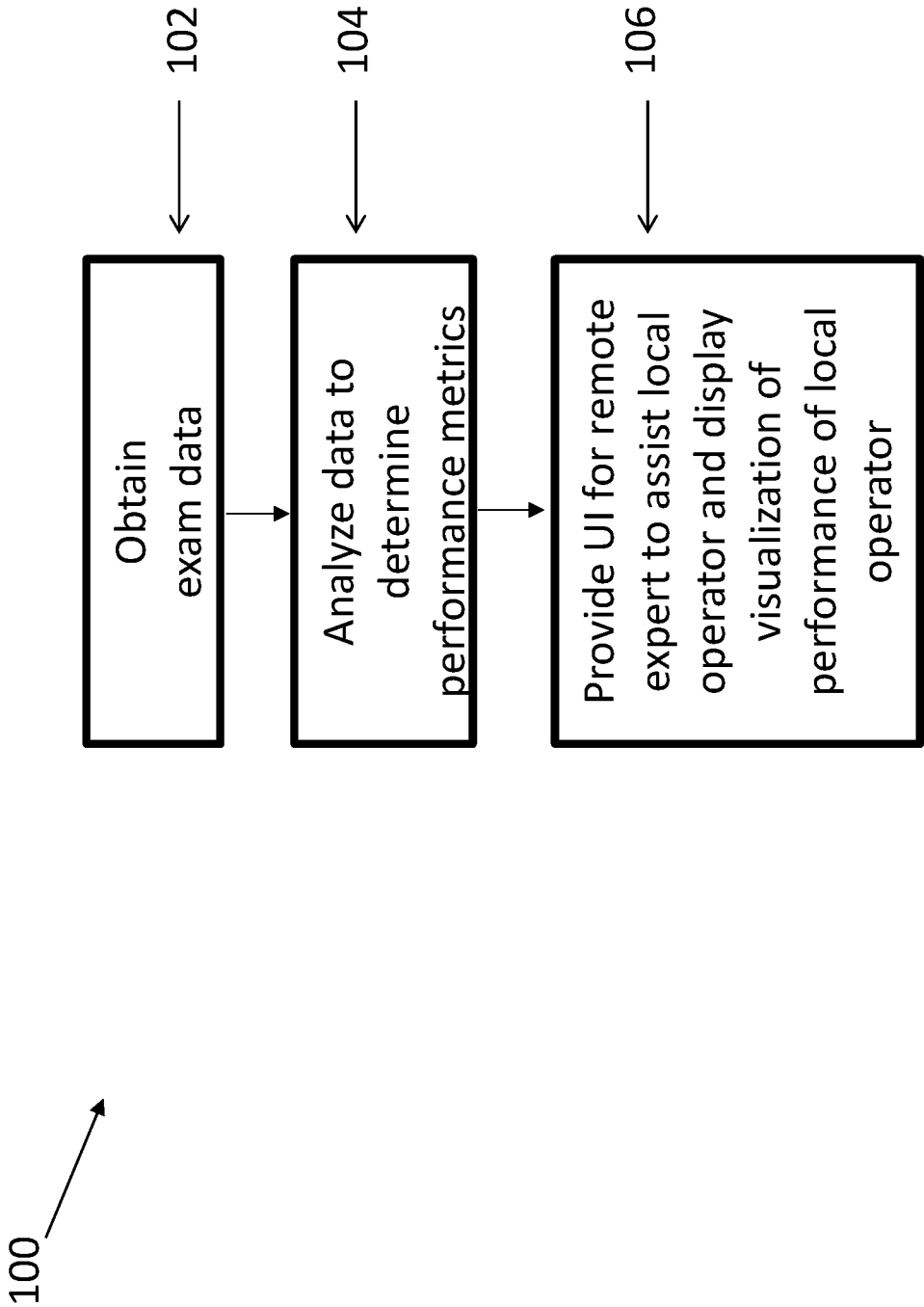


Figure 2

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Technologist	Modality	Scanner	Date	Procedure	CPT Code	Expert User Assistance	Procedure Duration	Exam Quality	Patient Feedback	Special Notes
Jason Friedman	MRI	Ingenia 1.5T S	11/23/19 1pm	MRI lumbar spine w/o dye	72148	None	40mins	Good		
Jason Friedman	MRI	Ingenia 3.0 T	11/23/19 3pm	MRI pelvis w/o & w/dye	72197	Yes (link to transcript)	42mins	Excellent		
Jason Friedman	MRI	Ingenia 1.5T S	11/23/19 4pm	MRI shoulder w/o&w/dye	73220	None	48mins	Needs Improvement		
Jason Friedman	MRI	Ingenia 3.0 T	11/24/19 9am	MRI brain w/o&w/dye	70553	None	75mins	Good		
Jason Friedman	MRI	Ingenia 1.5T S	11/24/19 11am	MRI pelvis w/o & w/dye	72197	Yes (link to transcript)	50mins	Good		
Jason Friedman	MRI	Ingenia 3.0 T	11/24/19 11:45am	MRI brain w/o&w/dye	70553	None	62mins	Rescan needed		
Jason Friedman	MRI	Ingenia 3.0 T	11/24/19 1pm	MRI shoulder w/o&w/dye	73220	None	41mins	Good		

Figure 3

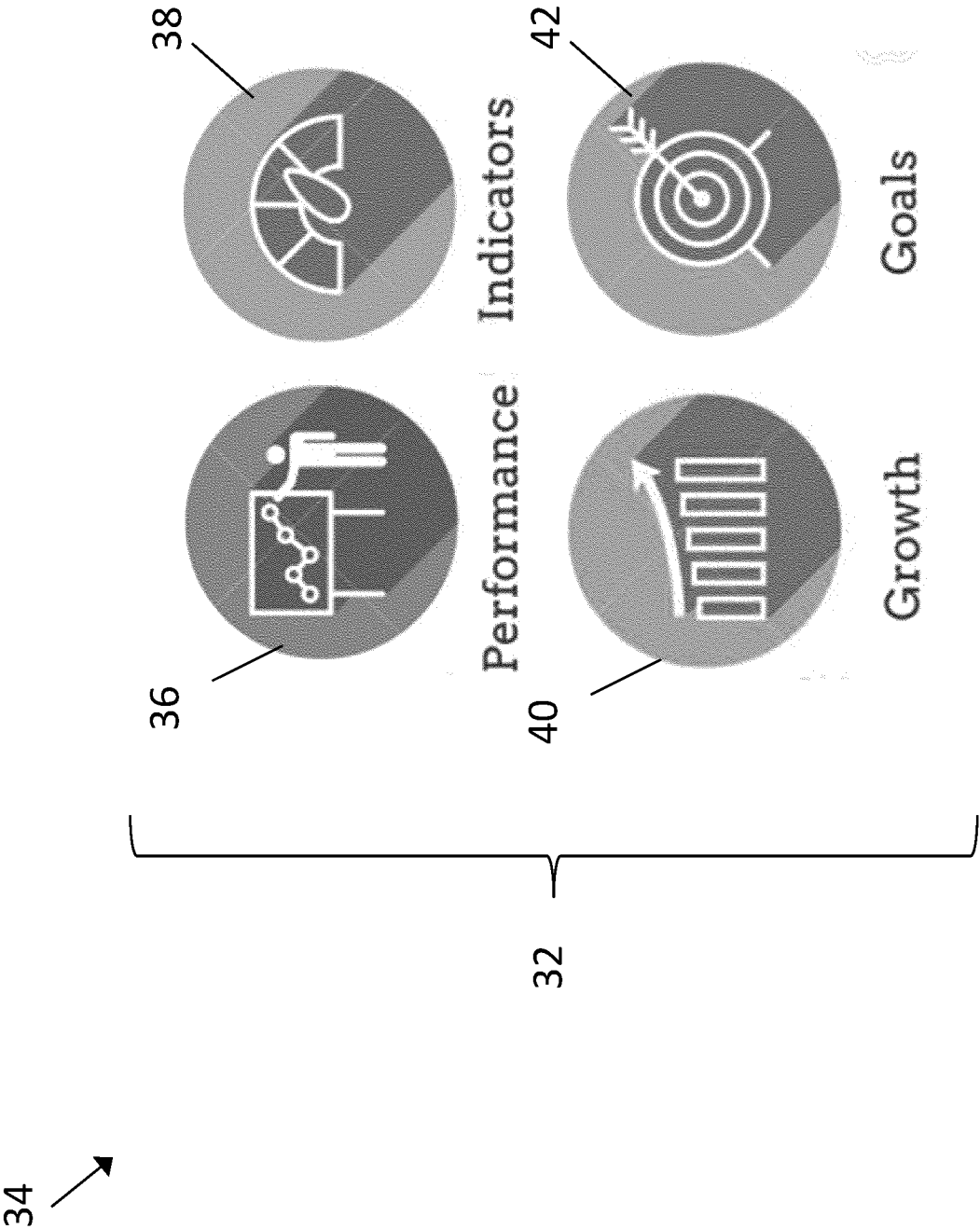


Figure 4

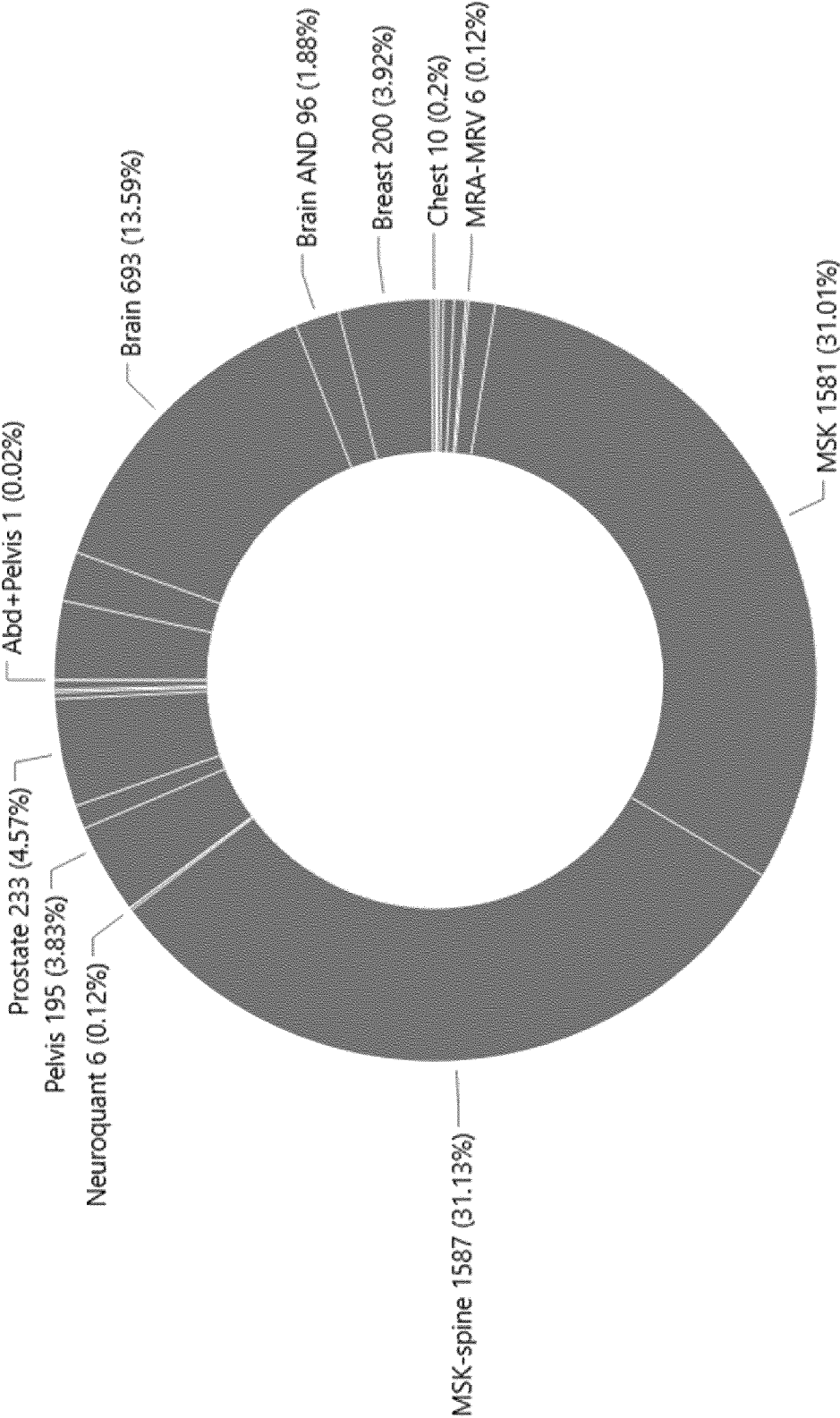


Figure 5A

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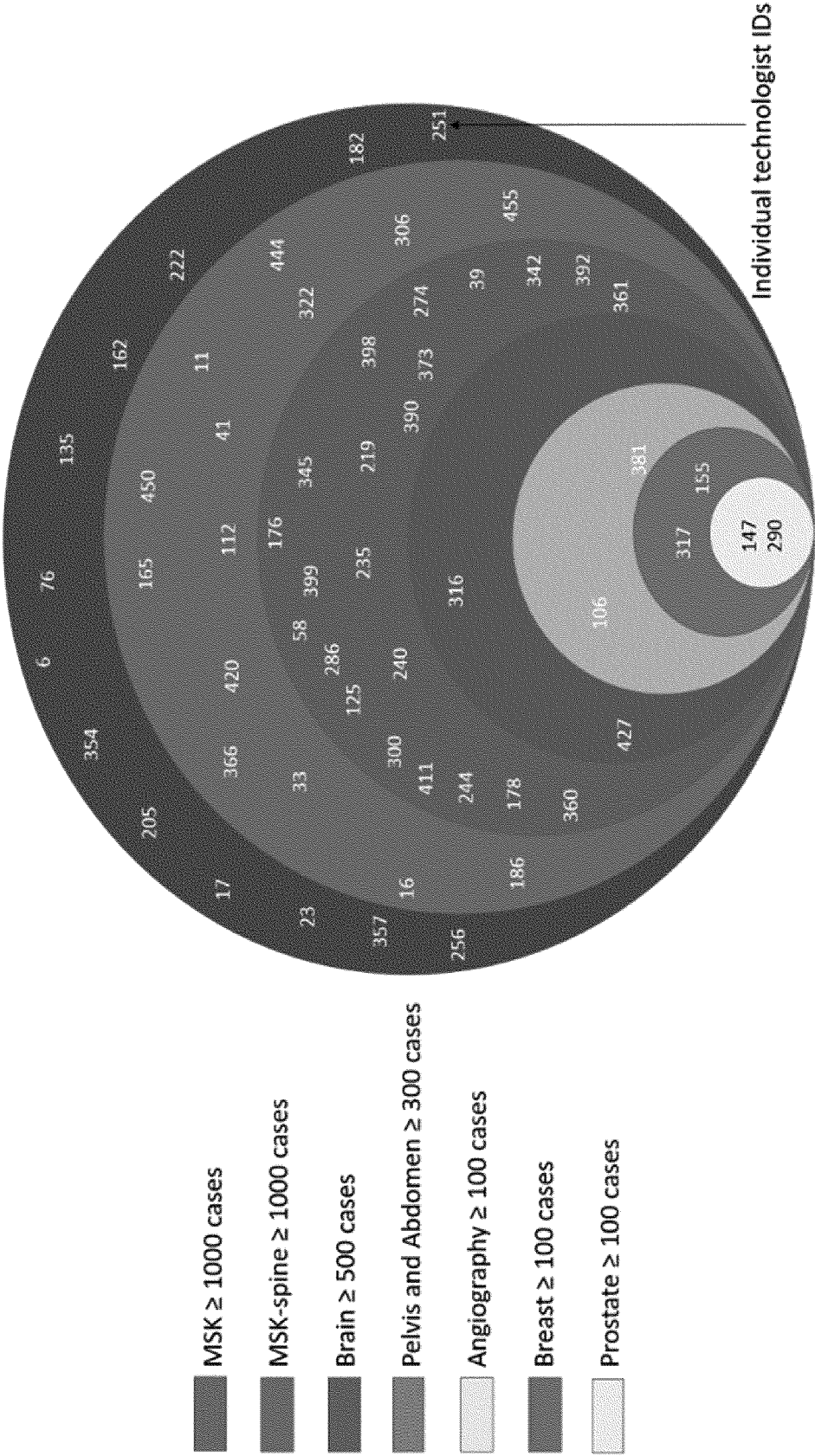


Figure 5B

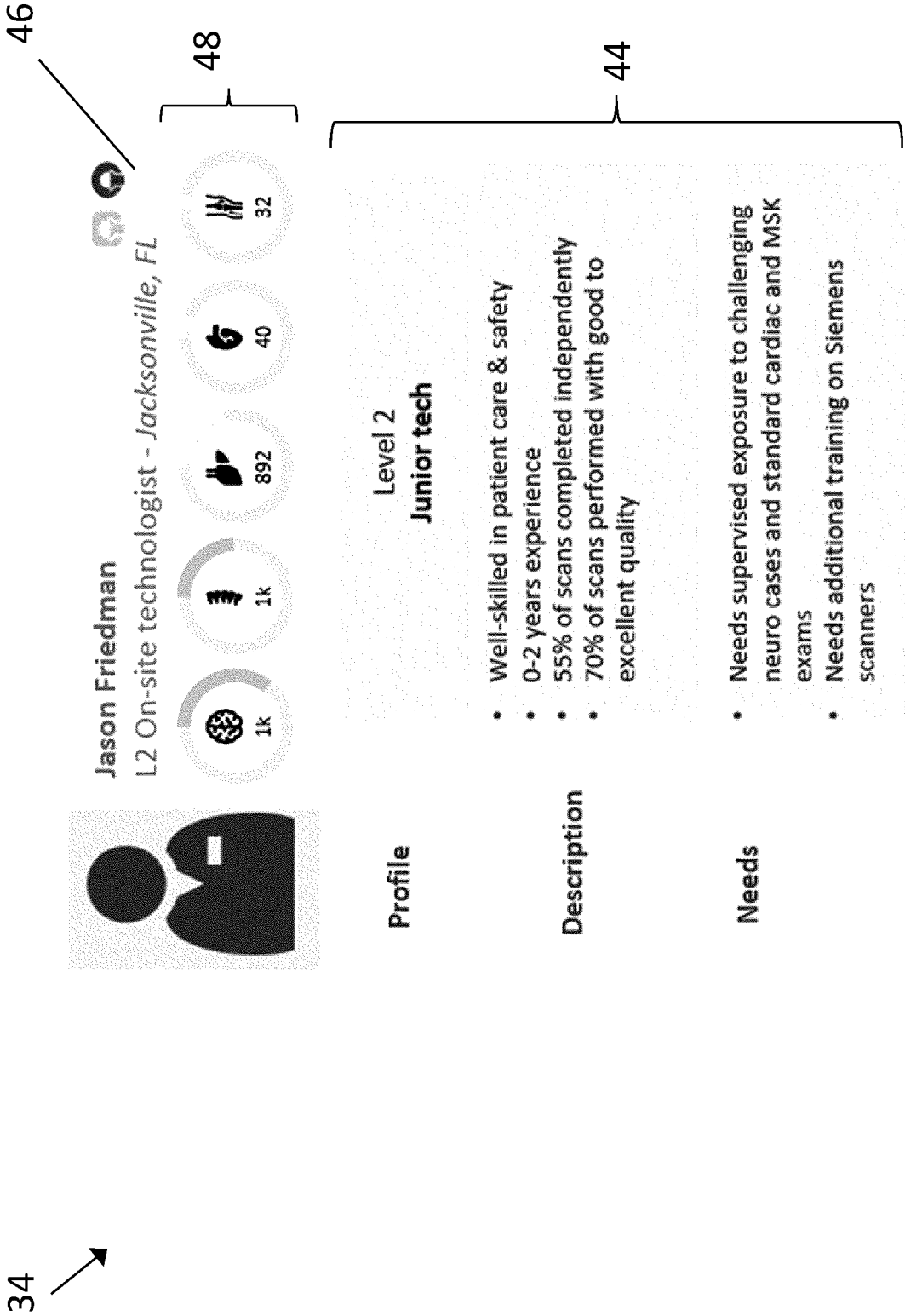


Figure 6

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2021/081005

A. CLASSIFICATION OF SUBJECT MATTER

INV. G16H40/20 G16H80/00
ADD.

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)
G16H

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

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

EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2017/105701 A1 (PELISSIER LAURENT [CA] ET AL) 20 April 2017 (2017-04-20) paragraphs 181-183, 22, 14, 15, 60, 77, 78, 145; figures 1 -----	1-20

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

☒ See patent family annex.

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Date of the actual completion of the international search

3 February 2022

Date of mailing of the international search report

14/02/2022

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/EP2021/081005

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2017105701 A1	20-04-2017	US 2017105701 A1	20-04-2017
		US 2020268344 A1	27-08-2020
