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(54) AUGMENTED-REALITY SYSTEM WITH VOICE-BASED RECORDING OF INFORMATION DATA, IN PARTICULAR OF SERVICE REPORTS

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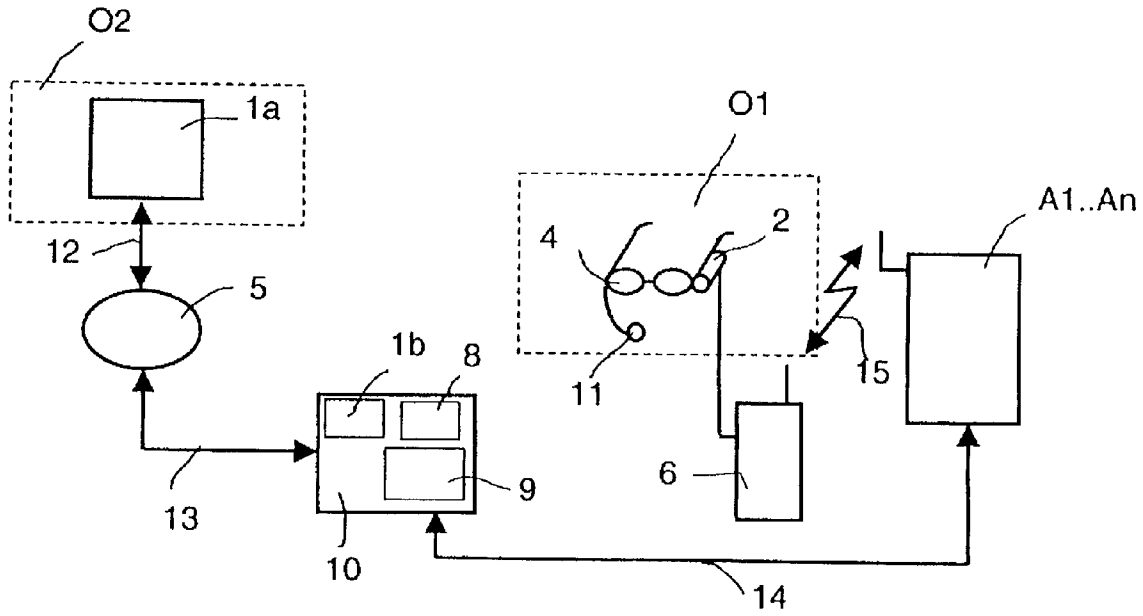
(57) **ABSTRACT**

The invention relates to an augmented-reality system and method for transmitting information data from a user, in particular of a process controlled by automation technology, of a production plant and/or of a machine, for example from a service technician to a storage medium in the augmented-reality system, where the augmented-reality system have recording means for recording voice inputs by the user, in particular service logs, using voice-based input. This means that service logs can easily be created quickly, stored centrally and archived, so that the appropriate information is reliably available even in the [lacuna] for later, similar instances of action.



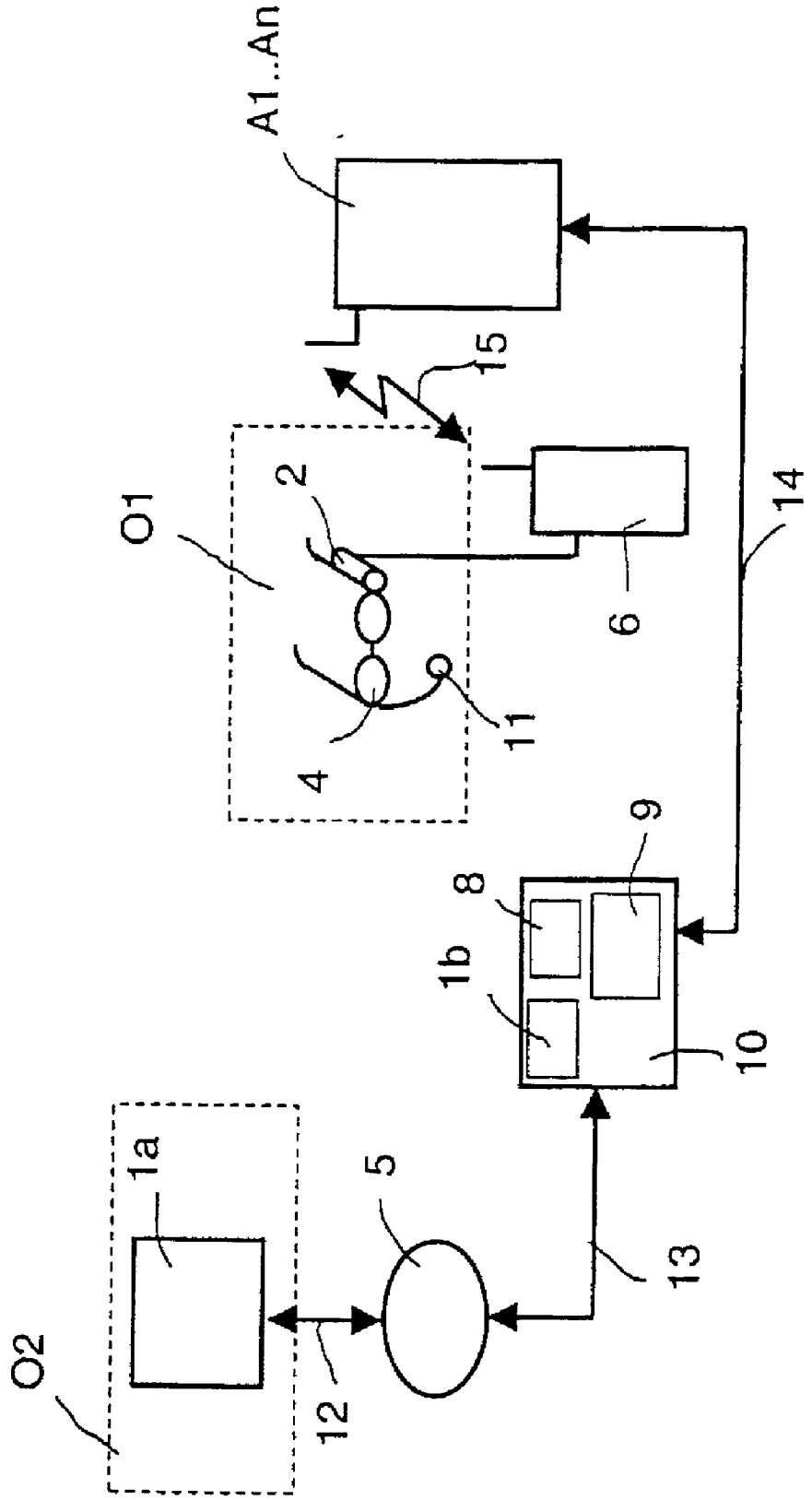


Fig. 1

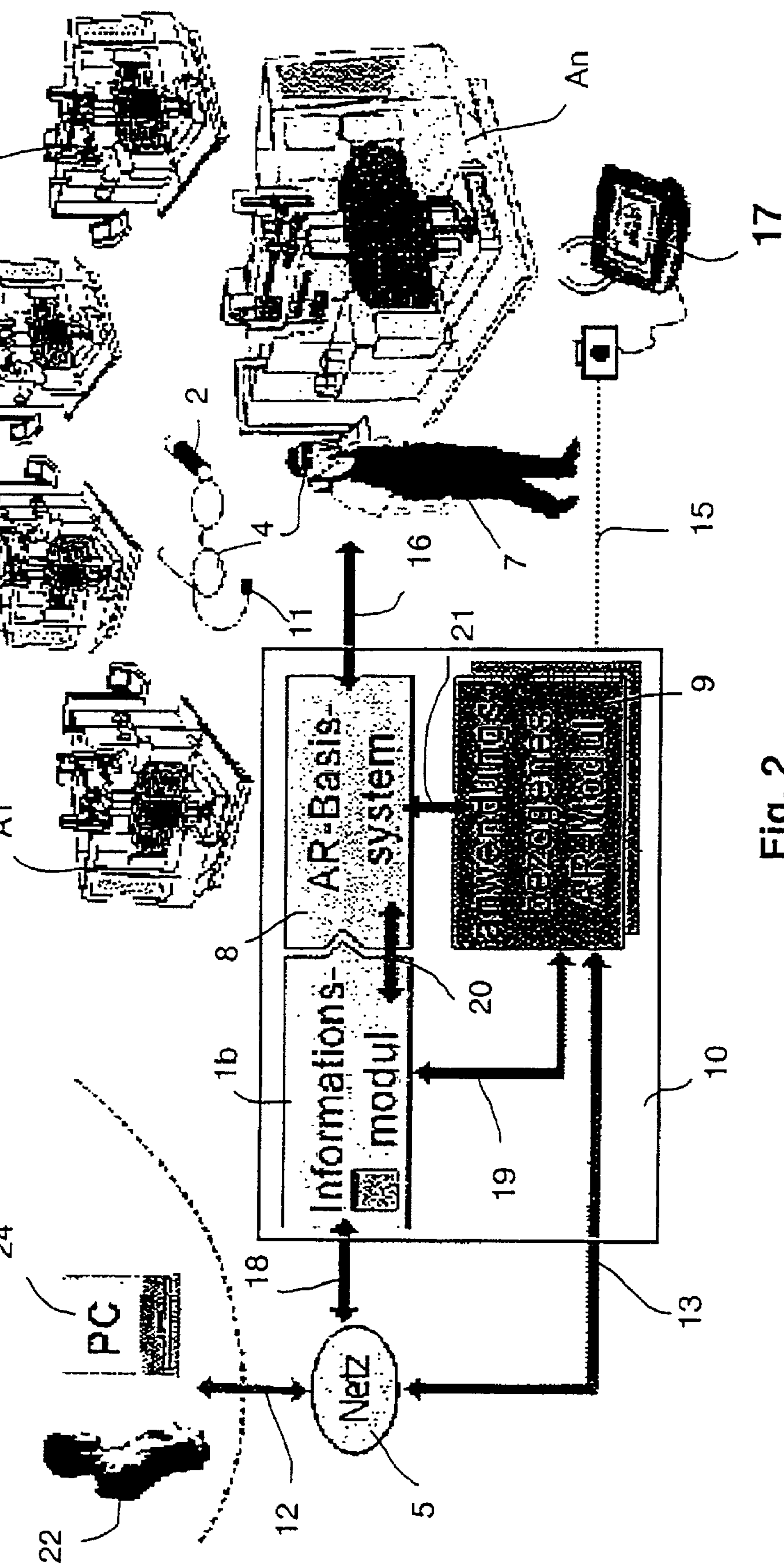

A1
A2
A3
A4
An
2
4
7
11
16
15
17
AR-Basis-system
8
21
anwendungsbezogenes AR-Modul
9
Informations-modul
1b
20
19
10
13
18
Netz
5
12
PC
24
22

Fig. 2

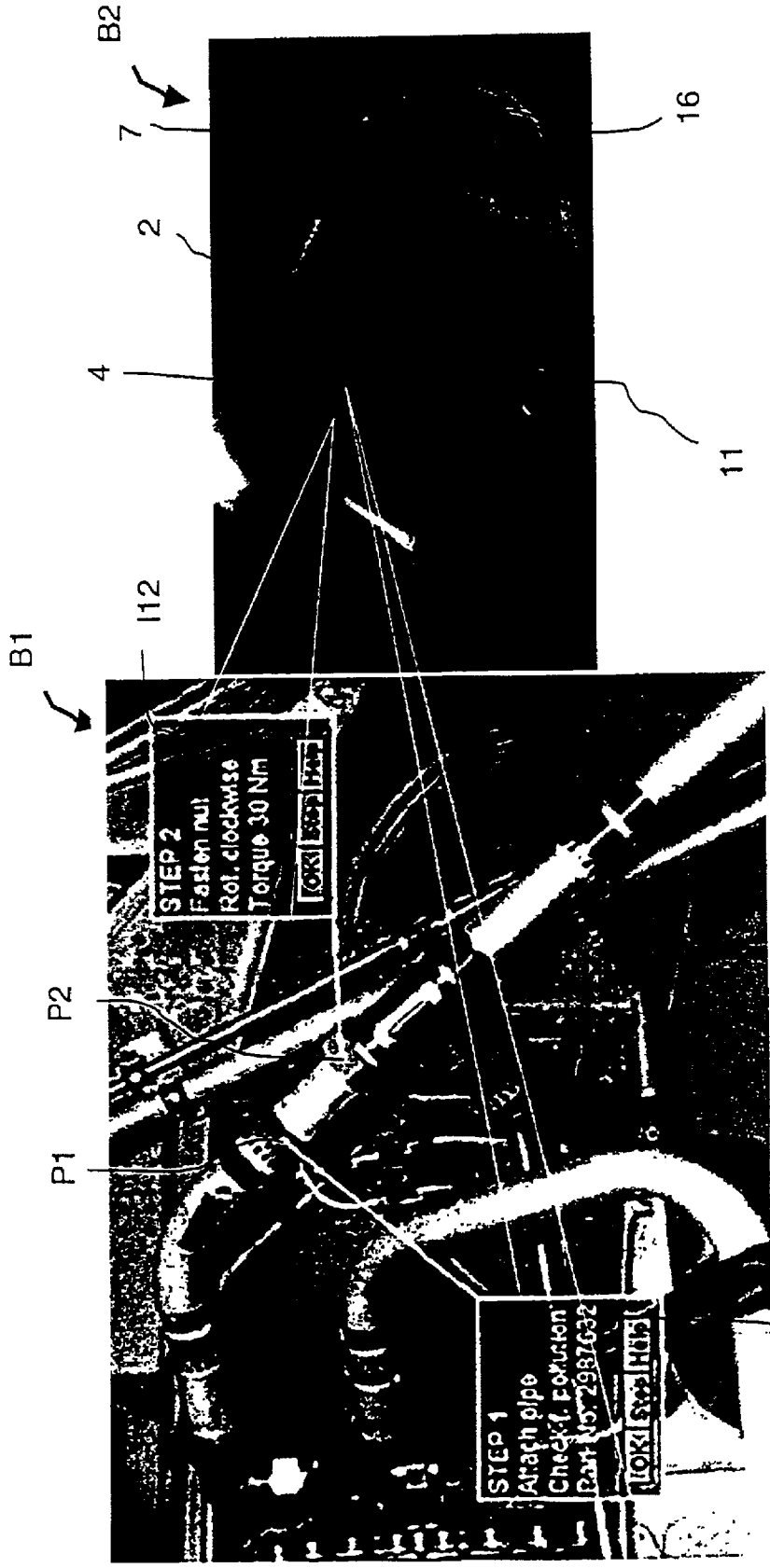

B2
7
2
4
16
11
I12
B1
P2
P1
I11
STEP 2
Fasten nut
Rot. clockwise
Torque 30 Nm
STEP 1
Attach pipe
Check connection

Fig. 3

AUGMENTED-REALITY SYSTEM WITH VOICE-BASED RECORDING OF INFORMATION DATA, IN PARTICULAR OF SERVICE REPORTS

BACKGROUND OF THE INVENTION

[0001] The invention relates to an augmented-reality system for transmitting information data from a user, for example from a service technician, to a storage medium in the augmented-reality system.

[0002] Such a system and method are used, for example, in the field of automation technology, for production machinery and machine tools, in diagnostic/service support systems, and for complex components, equipment and systems, such as vehicles and industrial machinery and installations.

[0003] The technical article Daude R. et al: "Head-Mounted Display als facharbeiterorientierte Unterstützungskomponente an CNC-Werkzeugmaschinen"[Head-mounted display as expert-oriented support component on CNC machine tools], Werkstattstechnik, DE, Springer Verlag, Berlin, Vol. 86, No. 5, May 1, 1996, pages 248-252, XP000585192 ISSN: 0340-4544, describes, with the head-mounted display (HMD), a component for supporting the expert for setting up, running in and fault management for milling work. The engineering link between the HMD and a modern NC-controller is explained and the results of a laboratory experiment with the HMD are stated.

[0004] The invention is based on the object of specifying a system and a method which permit simple and reliable recording and storage of information data, in particular of service reports.

[0005] This object is achieved by a system and by a method having the features specified in claims **1** and **9**, respectively. The invention is based on the insight that service staff with simple training often have only limited ability to document a servicing action in writing. The result of this is that no reliable information is available for future instances of action. The voice-based recording of the service reports, possibly also in connection with information data, i.e. documentation data and/or process data for an installation controlled by automation technology, provides a simple and reliable way of recording and storing the information data, in particular the service reports. In this case, the service reports can be stored and associated under voice control or under the control of the other recording means, such as image-recording means, i.e. in context-dependent fashion by the respective current operating situation ascertained by the recording means. When recording the action reports, in addition to the pure voice-based recording, it is also possible to record other data, such as process values, signal values, video images, at the same time. The augmented-reality system can provide the service technician who has been given a particular task with access to suitable, earlier, stored service logs, in the form of audio and/or image data, in situ on the basis of the problem which is set, so that the service technician profits, in a simple manner, from service actions which have already been recorded previously by colleagues, and an expert needs to be employed only in exceptional cases.

[0006] Advantageous refinements involve the documentation data being static and/or dynamic information data. Examples of such static information are engineering data from handbooks, exploded drawings, maintenance instructions etc. Examples of dynamic information are process values such as temperature, pressure, signals etc.

[0007] The invention is based on the insight that service staff with simple training often have only limited ability to document a servicing action in writing. The result of this is that no reliable information is available for future instances of action. The voice-based recording of the service reports, possibly also in connection with information data, i.e. documentation data and/or process data for an installation controlled by automation technology, provides a simple and reliable way of recording and storing the information data, in particular the service reports. In this case, the service reports can be stored and associated under voice control or under the control of the other recording means, such as image-recording means, i.e. in context-dependent fashion by the respective current operating situation ascertained by the recording means. When recording the action reports, in addition to the pure voice-based recording, it is also possible to record other data, such as process values, signal values, video images, at the same time. The augmented-reality system can provide the service technician who has been given a particular task with access to suitable, earlier, stored service logs, in the form of audio and/or image data, in situ on the basis of the problem which is set, so that the service technician profits, in a simple manner, from service actions which have already been recorded previously by colleagues, and an expert needs to be employed only in exceptional cases.

[0008] Advantageous refinements involve the documentation data being static and/or dynamic information data. Examples of such static information are engineering data from handbooks, exploded drawings, maintenance instructions etc. Examples of dynamic information are process values such as temperature, pressure, signals etc.

[0009] Rapid situation-related access to the documentation data is supported further by virtue of the recording means having an image-sensing apparatus, by virtue of the evaluation means being provided for evaluating the real information such that a use context, in particular an object of the documentation data, is ascertained from the real information, and by virtue of the system having visualization means for visualizing the documentation data.

[0010] Rapid situation-related access to the documentation data is supported further by virtue of the recording means being user-controlled and being, in particular, in the form of voice-controlled recording means and/or recording means controlled by control data.

[0011] Augmented-reality techniques on the basis of the static and/or dynamic documentation and/or process data can be used in a manner which is optimum for a large number of application instances by virtue of the recording means and/or the visualization means being in the form of data goggles.

[0012] The invention is described in more detail and explained below using the exemplary embodiments shown in the Figures, in which:

[0013] **FIG. 1** shows a block diagram of a first exemplary embodiment of an augmented-reality system;

[0014] **FIG. 2** shows another block diagram of an exemplary embodiment of an augmented-reality system; and

[0015] **FIG. 3** shows an application example of situation-related access to expert knowledge and/or documentation data.

[0016] **FIG. 1** shows a basic illustration of an augmented-reality system augmented-reality system for transmitting information data from a user, in particular of a process controlled by automation technology, of a production plant and/or of a machine, for example from a service technician to a storage medium in the augmented-reality system. The augmented-reality system has recording means **11** for recording voice inputs by the user **7**. Such voice inputs comprise, in particular, service logs using voice-based input. For this purpose, the user, who is not shown explicitly in **FIG. 1**, is equipped with mobile equipment **4**, **6**. The mobile equipment **4**, **6** comprises data goggles **4** holding a video camera **2** and a microphone **11**. The data goggles are coupled to a device for wireless communication, for example a radio transceiver apparatus **6** which can communicate with the automation system A1 . . . An via a radio interface **15**. The automation system A1 . . . An can be coupled by means of a data link **14** to an augmented-reality system **10**, which is also referred to as AR system for short below. The AR system contains an information module **1***b* for storing or accessing information data, an AR base module **8** and an AR application module **9**. In one advantageous embodiment, the AR system **10** can be connected to the one data network, for example to the Internet **5**, by means of a data link **13**, with an internet connection **12** (shown by way of example) permitting access to memory and documentation data **1***a*. Similarly, the voice data and/or other data from the user can be stored at the second location O2.

[0017] The user, equipped with the data goggles **4** and the mobile radio transmission device **7**, can move freely in the installation A1 . . . An for maintenance and servicing purposes. If, by way of example, maintenance or repair of a particular subcomponent in the installations A1 . . . An is necessary, then the camera **2** on the data goggles **4** is used, possibly controlled by voice commands recorded by the microphone **11**, to set up appropriate access to the relevant documentation data **1***a*, **1***b*, for example earlier, already recorded service reports. To this end, the radio interface **15** is used to set up a data link to the installation A1 . . . An or to an appropriate radio transmission module, and to transmit the data to the AR system **10**. In the AR system, the data obtained from the user are evaluated in relation to the situation, and information data **1***a*, **1***b* are accessed automatically or else under interactive control by the user. The relevant documentation data **1***a*, **1***b* ascertained are transmitted to the radio transmission device **6** via the data links **14**, **15**, and, on the basis of the operating situation recorded, all in all an analysis is thus performed which is the basis of the selection of data from the available static information. This results in situation-related, object-oriented or component-oriented selection of relevant knowledge from the most up-to-date data sources **1***a*, **1***b*. The information is displayed using the respective visualization component used, for example a hand-held PC or data goggles. AR-based technologies are referred to. The user in situ is thus provided only with the information which he needs. This information is always at the most up-to-date level. The service technician is not overloaded with information, for example by a "100 page manual".

[0018] **FIG. 2** shows another application example of a system for documentation processing for servicing and maintenance. The system comprises an augmented-reality system **10** which contains an information module **1***b* for storing information data, an AR base system **8** and an AR application module **9**. The AR system **10** can be coupled to the Internet **5** by means of link lines **13**, **18**. From the Internet, an illustrative data link **12** can be used to connect to a remote PC **16** with a remote expert **22**. The individual modules of the AR system **10** are coupled together by means of connections **19**, **20**, **21**. The user communication between a user **7** and the AR system takes place via interfaces **8**, **23**. To this end, the AR system can be coupled to a transceiver apparatus which permits two-way data communication between the AR system **10** and the user **7**, using data goggles **4**, either directly via the interface **8** or via an interface **23** using a radio transceiver device **17** arranged in the area of the user **7**. The connection **23** can be produced using a separate data link or using the electricity mains in the form of a "power-line" modem. Besides a display apparatus arranged in the area of the goggle lenses, the data goggles **4** contain an image-sensing apparatus **2** in the form of a camera, and also a microphone **11**. The user **7** can move in the area of the installations A1 . . . An using the data goggles **4** and can carry out servicing or maintenance work.

[0019] The data goggles **4** and the corresponding radio transceiver apparatuses, for example the radio transceiver apparatus **17** worn by the staff directly on the body, can be used to achieve preventive functionality: first, the respective operating situation is recorded, for example by the camera **2** or by localization by the staff **7**. On the basis of the recorded operating situation, the AR system selects data [lacuna] installation A1 . . . An being maintained. The fundamental advantage of the system shown in **FIG. 3** is that this system supports the interaction of the individual single functionalities on an application-related basis: thus, a concrete operating situation is first recorded automatically and this operating situation is then analyzed, with the currently relevant aspects being automatically ascertained from the most up-to-date, available static information in combination with the presently recorded dynamic data. This correlates assembly instructions, for example, to current process data. This provides the staff **7** with a situation-related display of the relevant information, for example by means of overlaid visualization of the appropriate data such that the real operating situation is extended by the ascertained information in the field of view of the staff. This very quickly equips the staff **7** to take action, and hence safeguards necessary machine execution times. The maintenance technician **7** can also obtain support in situ from the remote expert **22** and the knowledge **16** available at the location of the remote expert **22**.

[0020] **FIG. 3** shows an application example of situation-related access to documentation data. **FIG. 3** shows a first screen area B1 showing an installation component. The right-hand screen area B2 shows a user **7** looking at an individual installation component, for example. The user **7** is equipped with data goggles **4** containing a camera **2** as recording means. The data goggles **4** additionally hold a microphone **11** and a loudspeaker **16**. The left-hand screen

area B1 shows a view of pipelines which can be observed using the data goggles shown in the image window B2. In the left-hand screen area B1, two points B1, B2 are marked which respectively represent two image details observed using the data goggles **4**. After observation of the first point P1, i.e. after observation of the pipeline arranged in the area of the point P1, additional information is visualized in the data goggles **4** for the user **7**. This additional information **11** comprises documentation data which, for the first point P1, contain work instructions for this pipeline, and for the point P2, contain the installation instruction to be carried out in a second step. In this case, the installation instruction involves the user **7** being informed of the torque and the direction of rotation of the screw connection at the point P2 by means of visualization of the supplementary data **112**. The user **7**thus very quickly obtains a situation-related instruction for theobject being observed. If an intelligent tool is used which is capable of recording the torque currently being used, it is additionally possible for the user also to be requested to increase or reduce the torque appropriately on the basis of the current torque. Such additional information can be embedded into the AR system in a service report under voice control when service logs are created by the service technician. This means that, if there is a new fault, maintenance which has been carried out earlier or a service action which has been carried out earlier can be reconstructed exactly. Analysis of the service logs recorded in this manner leads to better recognition of quality deficiencies in an installation and/or in a process controlled by automation technology.

[**0021**] The text below provides background information on the field of use of the invention: this involves application-oriented requirement analysis and development of AR-based systems for supporting work processes in development, production and servicing of complex engineering products and installations in fabrication and process technology, and also for service support systems, as in the case of motor vehicles, or for maintenance of any engineering equipment.

[**0022**] Augmented reality, AR for short, is a novel type of man-machine interaction with great potential for supporting industrial work processes. With this technology, the observer's field of view is enriched with computer-generated virtual objects, which means that product or process information can be used intuitively. Besides the very simple interaction, the use of portable computers opens up AR application fields with high mobility requirements, for example if process, measurement or simulation data are linked to the real object.

[**0023**] The situation of German industry is characterized by increasing customer requirements in terms of individuality and quality of products and by the development processes taking substantially less time. Especially in developing, producing and servicing complex engineering products and installations, it is possible, by means of innovative solutions to man-machine interaction, both to achieve jumps in efficiency and productivity and to design the work so as to enhance competence and training, by the user's need for knowledge and information being supported in a situation-related manner on the basis of data available in any case.

[**0024**] Augmented reality is a technology with numerous innovative fields of application:

[**0025**] In development for example, a "mixed mock-up" approach based on a mixed-virtual environment can result in a distinct acceleration of the early phases of development. Compared with immersive "virtual reality" (VR) solutions, the user is at a substantial advantage in that the haptic properties can be depicted faithfully with the aid of a real model, whereas aspects of visual perception, e.g. for display variants, can be manipulated in a virtual manner. In addition, there is a major potential for user-oriented validation of computer-assisted models, e.g. for component verification or in crash tests.

[**0026**] In flexible production, it is possible, inter alia, to considerably facilitate the process of setting up machinery for qualified skilled workers by displaying, e.g. via mobile AR components, mixed-virtual clamping situations directly in the field of view. Fabrication planning and fabrication control appropriate to the skilled worker in the workshop is facilitated if information regarding the respective order status is perceived directly in situ in connection with the corresponding products. This also applies to assembly, with the option of presenting the individual work steps to the assembler in a mixed-virtual manner in the actual training phase. In this connection, it is possible, e.g. by comparing real assembly procedures with results of simulations, to achieve comprehensive optimizations which both improve the quality of work scheduling and simplify and accelerate the assembly process in the critical start-up phase. Finally, regarding servicing, conventional technologies are by now barely adequate for supporting and documenting the complex diagnostic and repair procedures. Since, however, these processes in many fields are in any case planned on the basis of digital data, AR technologies provide the option of adopting the information sources for maintenance purposes and of explaining the dismantling process to an engineer, e.g. in the data goggles, by overlaying real objects. Regarding cooperative work, the AR-assisted "remote eye" permits a distributed problem solution by virtue of a remote expert communicating across global distances with the member of staff in situ. This case is particularly relevant for the predominantly medium-sized machine tool manufacturers. Because of globalization, they are forced to set up production sites for their customers worldwide. Neither, however, is the presence of subsidiaries in all the important markets achievable on economic grounds, nor is it possible to dispense with the profound knowledge of experienced service staff of the parent company with respect to the increasingly more complex installations.

[**0027**] The special feature of man-machine interaction in augmented reality is the very simple and intuitive communication with the computer, supplemented, for example, by multimode interaction techniques such as voice processing or gesture recognition. The use of portable computer units additionally enables entirely novel mobile utilization scenarios, with the option of requesting the specific data at any time via a wireless network. Novel visualization techniques permit direct annotation, e.g. of measured data or simulation data, to the real object or into the real environment. In conjunction with distributed applications, a number of users are able to operate in a real environment with the aid of a shared database (shared augmented environments) or to cooperate in different environments with AR support.

[0028] Augmented reality has been the subject of intense research only in the last few years. Consequently, only a few applications exist, either at the national or the international level, usually in the form of scientific prototypes in research establishments.

[0029] USA: As with many novel technologies, the potential uses of augmented reality were first tapped in North America. Examples include cockpit design or maintenance of mechatronic equipment. The aircraft manufacturer Boeing has already carried out initial field trials using AR technology in the assembly field. The upshot is that in this hi-tech area too, the USA occupy a key position, potentially making them technological leaders.

[0030] Japan: Various AR developments are being pushed in Japan, e.g. for mixed-virtual building design, telepresence or "cyber-shopping". The nucleus is formed by the Mixed Reality Systems Laboratory founded in 1997, which is supported jointly as a center of competence by science and by commerce and industry. Particular stimuli in the consumer goods field are likely in the future from the Japanese home electronics industry.

[0031] Europe: So far, only very few research groups have been active in Europe in the AR field. One group at the University of Vienna is working on approaches to mixed-real visualization. The IGD Group, as part of the ACTS project CICC, which has now come to an end, has developed initial applications for the building industry and a scientific prototype for staff training in car manufacturing.

[0032] The in the invention should be seen in particular in the specific context of the fields of application "production machinery and machine tools" (NC-controlled, automation-technology processes) and "diagnostics/service support systems for complex engineering components/equipment/systems" (e.g. vehicles, but also industrial machinery and installations).

[0033] In summary, the invention therefore relates to an augmented-reality system and method for transmitting information data from a user, in particular of a process controlled by automation technology, of a production plant and/or of a machine, for example from a service technician to a storage medium in the augmented-reality system, where the augmented-reality system have recording means for recording voice inputs by the user, in particular service logs, using voice-based input. This means that service logs can easily be created quickly, stored centrally and archived, so that the appropriate information is reliably available even in the [lacuna] for later, similar instances of action. The method permits voice-based recording of action reports, in which service logs etc. are stored and managed as voice-based inputs instead of in written form.

We claim:

1. A system for recording and storing information data, where the system has recording means for recording a service report in the form of voice inputs by a user means for recording documentation data and process data for an installation controlled by automation technology, and a storage medium for storing the voice inputs, the documentation data and the process data.

2. The system according to claim 1, wherein the documentation data and the process data are recorded in connection with the voice inputs by the user.

3. The system according to claim 1, wherein voice-controlled storage and association of the service reports are provided.

4. The system as claimed according to claim 1, wherein recording means for recording a current operating situation are provided, and in that storage and association of the service reports on the basis of the current operating situation are provided.

5. The system as claimed according to claim 1, wherein the system has visualization means for visualizing information data stored in the system.

6. The system according to claim 4, wherein means are provided for displaying the stored information data on the basis of the current operating situation.

7. The system according to claim 1, wherein the recording means are user-controlled.

8. The system according to claim 5, wherein the visualization means are in the form of display apparatuses arranged in the area of goggle lenses of data goggles, in that the recording means provided is an image-recording apparatus arranged on the data goggles, and in that a microphone arranged on the data goggles is provided for recording voice commands.

9. A method for recording and storing information data, where recording means are used to record a service report in the form of voice inputs by a user documentation data and process data for an installation controlled by automation technology are recorded, and the voice inputs, the documentation data and the process data are stored.

10. The method according to claim 9, wherein the documentation data and the process data are recorded in connection with the voice inputs by the user.

11. The method according to claim 9, wherein voice-controlled storage and association of the service reports are provided.

12. The method according to claim 9, wherein recording means are used to ascertain a current operating situation, and in that storage and association of the service reports on the basis of the current operating situation are provided.

13. The method according to claim 9, wherein information data stored in the system are visualized using visualization means.

14. The method according to claim 12, wherein the stored information data are displayed on the basis of the current operating situation.

15. The method according to claim 9, wherein the recording means are user-controlled.

16. The method according to claim 13, wherein the visualization means are in the form of display apparatuses arranged in the area of goggle lenses of data goggles, in that the recording means provided is an image-recording apparatus arranged on the data goggles, and in that a microphone arranged on the data goggles is provided for recording voice commands.

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