



System and method for controlling a data transmission to
and/or from a plurality of medical devices

Description

The invention relates to a system and a method of controlling a transmission of data to and/or from a plurality of medical appliances according to the preambles of claims 1 and 9.

In clinics and hospitals, networks for the transmission of data are frequently made available, which are provided in order to make available data communication with a plurality of medical appliances on the one hand and a server or a server device on the other hand. Networks of this type have the task of data transmissions taking place in near real time. This applies both to data which are produced at the medical appliances which are frequently connected to patients who occupy a hospital bed and which have to be sent to the central server device in order to monitor, evaluate and display the data, and to data which are to be sent from the server device centrally to the various medical appliances. This data transmission has to be carried out in near real time and in a trouble-free manner, which is frequently not possible just as all the medical appliances access a common network and overloading of the network frequently occurs as a result of this.

In addition, an overloading of this type can lead to an interruption in the data transmission and, in this way, a trouble-free data transfer cannot be carried out. This frequently results in large intermediate memories being provided in the medical appliances in order to store the



data - which are currently being produced in the medical appliance or have been received beforehand - temporarily in the event of failure or overloading of the network.

Reading out this intermediate memory is made possible again only if a fixed data transmission connection to the server device has been set up, for example after the reduction of an overloading of the network.

Consequently, the object of the present invention is to make available a system and a method of controlling a transmission of data to and/or from a plurality of medical appliances, which will provide a trouble-free continuous transmission of data between the medical appliances on the one hand and a server device on the other hand, without a loss of data during near real time transmission of the data and an overloading of a network taking place.

This object is attained with respect to the system by the features of claim 1 and with respect to the method by the features of claim 9.

An essential aspect of the invention lies in the fact that in the case of a system for controlling a transmission of data to and/or from a plurality of medical appliances, the plurality of medical appliances being subdivided into individual groups with at least one medical appliance in each case, each group of medical appliances on a first data transmission stage is directly connected by way of a first network in each case to a communication device arranged on a second data transmission stage for the transmission, storage and control of data, and means are provided which are

designed in order that a plurality of these communication devices on a third data transmission may exchange data with a common central server device arranged on a third data transmission stage for the storage, control and transmission of data. Means of this type can be a second network which connects the communication device directly to the server device. Alternatively or in addition, means of this type can constitute external storage media, such as for example USB sticks or memory cards which can be used for the transmission of data.

By means of a system of this type for controlling a transmission of data it is advantageously made possible that on account of the multiple-stage arrangement of the individual system components involved in the transmission of data not only the overloading of the network with data is minimized and thus an overloading of the networks involved is prevented, but a trouble-free transmission of data between the medical appliances on the one hand and the server device on the other hand is also ensured. This is because on account of the connection of the individual medical appliances, which are divided into groups, to one communication device in each case, which is otherwise designed in such a way that it can communicate in an autarkical manner, i.e. independently of the server device, with the medical appliances, which are preferably infusion pumps, and can also store data, a direct connection between a communication device in each case on the one hand and a medical appliance on the other hand is formed as an exclusive connection of the first network.

This has the result that when using a network of the CAN type for example no overlapping of data or data packets in terms of time or quantities can occur between medical

appliances and a centrally arranged server device, since the exclusive direct line between the communication device and one of the medical appliances reduces and almost eliminates the latency times and data losses in the transmission of data. As a result of this, not only repetition loops, which frequently have to take place for a successful transmission of data by way of a network which is to ensure the supply of a plurality of medical appliances at the same time, but also update terminations during the updating of the software of the medical appliances are prevented.

In addition, on account of this direct line between the communication device and the medical appliances a trouble-free transmission of data from the medical appliance to the communication device or vice versa can take place. This can relate to both appliance-specific and patient-specific data on patients who are connected up to the medical appliances, such as insulin pumps, and medicine-specific data which are to be transmitted from the server device to the medical appliances.

To this end the central server device has an application server unit and a memory unit, the application server unit being connected to application operation units on a fourth data transmission stage by means of a third network. In this way, a plurality of application operation units are arranged on a further data transmission stage of this communication structure built up in the form of a cascade or a multiplicity of stages, as a result of which a plurality of devices, units and medical appliances loosely communicating with one another are formed on various stages of this communication structure and they can function and act relatively

independently in order to continue to maintain the communication with the adjacent devices / units / medical appliances of the next lower or the next higher stage. This makes possible a reduction in the susceptibility to communication failures, such as can frequently occur for example in the use of wireless LAN (WLAN) with a server which is directly connected to the medical appliances in the entire clinic by way of a network of this type.

Each communication device is provided for this purpose with at least one first memory unit and one first control unit in order to store temporarily data arriving and received from the medical appliances of the group, in particular appliance-specific and patient-specific data on patients who are connected up to the medical appliances, and to pass them on in a bundled manner to the memory server unit.

In the same way, the first memory unit and the first control unit of each communication device are suitable for storing temporarily data arriving and received from the memory server unit or application server unit, in particular medicine-specific data, and to pass them on to selected medical appliances upon demand or if required. This makes it possible for data to be capable of being sent both from the communication device to the medical appliances and from the medical appliances to the communication device, in which case all the data can be temporarily stored inside each communication device and can optionally also be read directly out of or written into this communication device without the aid of a server device. As a result, a virtually independent first network is possible between a group of medical appliances on the one hand and at least one communication

device on the other hand.

In the same way, the second network which is built up between a plurality of communication devices of this type on the one hand and the server device on the other hand, should be regarded as being a network system independent of the other networks. In this respect a transmission of data from the server device to the individual communication devices, which is necessary for example in order to pass on data on medicines which are available in a new form by way of the server device, to the individual communication devices and thus to the medical appliances, can take place first by means of the second network, and these data can be stored temporarily inside the individual communication devices in order to be subsequently passed on to the medical appliances if required and in a suitable operating state of the aforesaid medical appliances. This can be present for example if the medical appliance designed in the form of an insulin pump is not carrying out any administration of medicine in the form of insulin to the patient.

In addition, the third network between the server device and the application operation units, which can be arranged at a distance from the server device, is to be regarded as being autarkic. This independent third network can connect the application operation units to the application server unit by means of a web interface and a web browser for example and can thus permit the operation, control, uploading and reading out of the data stored on the server device.

The data which are stored on the server device and which are preferably stored in the memory server unit can likewise be displayed visually, it being possible for this

display to take place both on the server device and in one or more application operation units which are arranged at a distance from the server device.

A method according to the invention for controlling the transmission of data to and/or from the plurality of medical appliances is characterized in that each group of medical appliances on a first data transmission stage transmits data from or to a communication device arranged on a second data transmission stage by way of a first network in each case and stores them at the receiver location or at the transmission location and optionally uses them to control the appliance or the device respectively. These can be appliance-specific configuration data, appliance-specific medicine data, appliance-specific software programs as well as the collection and evaluation of appliance-specific status information and the collection and evaluation of appliance-specific therapy information.

The appliances, which operate on the first data transmission stage and which otherwise operate likewise virtually independently of the power supply and thus function in an autarkic manner, are thus controlled by the communication devices by way of configuration files and commands and pass on operating, status and medical data to the communication device the other way round.

The communication devices on the second data transmission stage are likewise designed to operate virtually independently of the network and, in particular, in a manner autarkic of the server device, and they receive configuration files and commands from the server device on occasion in order to pass these on to the medical

appliances attached to the respective communication device.

Operating, status and medical data of all the attached medical appliances are likewise received and temporarily stored the other way round in order to then pass them on bundled or concentrated to the server device on the third data transmission stage.

In addition, the time-wise and functional behaviour of the communication devices is preferably controlled by way of the central server device on the third data transmission stage by the transmission of control data of this type.

The server device arranged on the third data transmission stage is preferably arranged centrally inside the clinic and is controlled by the application operation units on the fourth data transmission stage. A control of this type can cause the appliance-specific configuration data and commands to be passed on to selected communication devices of the second data transmission stage. Operating, status and medical data of all the attached communication devices of the second data transmission stage are likewise temporarily stored inside this third transmission stage, i.e. inside the server device.

The application operation units arranged in the fourth data transmission stage produce the configuration files and commands in an automated manner or with the aid of clinical staff. In addition, they make a selection of the communication units to be activated and define the functional and time-wise behaviour of the communication devices, by making available the data or information

required for this in the server device according to the third data transmission stage.

The application operation units can also evaluate, concentrate and illustrate the operating, status and medical data, which are temporarily stored in the server device, in a suitable manner.

The application server unit is operated, controlled and regulated with respect to writing and reading data by the application operation units.

In the case of the method according to the invention, data which are received in at least one first memory unit and by means of a first control unit and which are transmitted by the medical appliances of the group, in particular appliance-specific and patient-specific data of patients who are connected up to the medical appliances, are stored temporarily and bundled in each communication device and are passed on to the memory server unit.

The data, in particular medicine-specific data, are likewise received and temporarily stored by the memory server unit or the application server unit by means of the first memory unit and the first control unit in order to send them on to selected medical appliances on demand or when required. This can occur for example when the medical appliance is in an operating state suitable for the updating with data. The communication device then carries out the transmission and the updating of the data in the medical appliance in an independent manner. To this end the data of all the medical appliances are continuously read out from the communication device and

are temporarily stored inside the communication device.

As soon as these temporarily stored data, to which operating-status data of the medical appliances also belong, indicate that a suitable operating mode of the medical appliance is present, updating of a data bank of the medical appliance is carried out by the communication device. This must not take place in an operating state during which a current therapy by the medical appliance is being carried out.

It is preferable for the presence of new data, as well as also new configurations, to be indicated visually inside the medical appliance.

The first network is preferably of the CAN type and the second and third networks are of the WLAN and/or LAN type.

Further advantageous embodiments are set out in the sub-claims.

Advantages and expedient features are evident from the following description in conjunction with the drawing.
In the drawing

Figure 1 is a diagrammatic illustration of the system according to the invention built up in a multiplicity of stages, and

Figures 2a and 2b show a possible application of the multiple-stage system and method according to the invention in flow charts in the form of one embodiment.

A diagrammatic illustration of the basic design of the

system according to the invention for performing the method according to the invention for controlling the data transmission of a plurality of medical appliances is shown in figure 1.

This system permits the control and configuration of a plurality of medical appliances without failure of the transmission of data and without overloading the networks connected to them as well as the collection and visualization of further data which are sent by the medical appliances and are collected centrally for evaluation and monitoring purposes.

There are altogether four data transmission stages 1 to 4, a plurality of medical appliances 5, such as insulin pumps, being arranged subdivided into different groups 5a in the first data transmission stage 1.

One group 5a of medical appliances is assigned in each case to a communication device 6 with a first storage unit 6a and a first control unit 6b. This is carried out by means of an exclusive network based on CAN in accordance with the reference number 7. In this way, there is an exclusive CAN connection 7 between the communication device and each medical appliance assigned to it.

The plurality of communication devices 6 are connected in turn to a centrally arranged server device 8 by way of a second network 9, it being possible for the server device 8 to be subdivided into a memory server unit SS and an application server unit AS.

The server device 8 can in turn be connected by means of a third network 11 from the third data transmission stage 3 to the application operation units 10a, 10b, 10c which

are arranged on the fourth data transmission stage 4 and which permit different applications A, B, C.

Such a multiple-stage design of the system according to the invention for promoting the transmission of data permits a trouble-free transmission of data which is not susceptible to overloading by way of the available networks.

An embodiment with a possible implementation of the method according to the invention, for which the system according to the invention is necessary, is illustrated in a flow chart in figures 2a and 2b.

First of all, a new updated medicine data bank is set up by means of one of the application operation units. This is carried out in accordance with step 21.

After that, the medicine data bank is stored by the transmission of a corresponding control signal from the application operation unit to the server device 8 in accordance with step 22.

In accordance with step 23 all the communication devices 6 receive the notification that a new medicine data bank is available in the server device. After that, by demand or by sending the data for the new medicine data bank when required, a transmission of the medicine data banks takes place from the server to all the communication devices in accordance with step 24. This is carried out by way of the second network after the third network has been used in the transmission from the application operation units to the memory device.

The communication devices continuously receive data - from the medical appliances attached to them - on the current state or status of the respective medicine data bank, which are stored for the moment in the respective medical appliances.

As soon as this checking has been carried out in accordance with step 25, an enquiry is made - in a step 26 by sending an interrogation signal from the communication device to the respective medical appliance or by checking the current data which are present inside the communication device to the respective appliance - as to whether the data on the new medicine data bank are identical with the data on the previously present medicine data bank in the respective medical appliance. If this is the case, an updating of the medicine data bank does not take place in accordance with step 27.

If the data of the medicine data bank do not correspond, an enquiry is made in a further step 28 as to whether the medical appliance in question has assumed an operative state which allows an updating of the data bank or whether it is in a therapy method at the moment. If an operating state of the medical appliance is present which allows updating, then in accordance with step 29 an updating of the data bank of the medical appliance is carried out by the transmission of the data of the medicine data bank from the communication device of the medical appliance. After that, an actuation of the portion 31 is carried out, according to which the current operative state is sent from the medical appliance to the communication device.

If the operative state does not allow updating for the

moment, in accordance with step 30 a notification on the update made available is sent from the communication device to the medical appliance. In response to this, in accordance with step 31, the medical appliance sends the current operative state to the communication device which in turn in accordance with step 32 sends it in the current operative state to the server which in accordance with step 33 stores the current operative state in order to update the central data bank on the operative states of all the appliances.

The communication device constantly checks the operative state of the medical appliances (step 28) and independently carries out an update as soon as the operative state of a medical appliance allows an update.

In accordance with arrow 34 a repeated enquiry as to the operative state by the communication device takes place until it is established that the operative state of the medical appliance in accordance with step 28 allows an updating of the medical appliance to be possible.

Consequently, during the transmission of operative and status information of the medical appliances to the server devices two stages of the transmission of data are followed, namely the transition from the first data transmission stage to the second data transmission stage and the transition from the second data transmission stage to the third data transmission stage.

On account of the first network - used exclusively by a medical appliance - with the communication device a current enquiry as to the operative state and a possibly occurring change of operative and status data of the in-

dividual medical appliance with a high degree of transmission quality and a low degree of failure is possible. These operative and status data are temporarily stored inside the communication device and prepared in order then to send them on in a bundled manner to the server device by means of the second network.

In this case the communication device records which data are sent when to the server device by means of the second network, and as a result it is capable of restricting the transmission of data to the server device to the recently arrived or received data.

If a failure of the second network were to occur, all the data for pre-definable periods of time are temporarily stored inside the communication devices and they are transmitted completely to the server device when the second network becomes available again.

In accordance with a further embodiment of the invention it is possible for data also to be sent directly to other third systems from the communication device, without this having to take place by way of the server device. For this purpose, protocol adaptations can also be carried out inside the communication device.

On account of the reduction of the data - to be transmitted from each communication device 6 to the server device - to those data which have previously not yet been transmitted, it is possible to eliminate overloading of the second network 9. In the same way, the loss of data and latency times inside the first network 9 are eliminated as a result of the direct

connection between each communication device 6 and each medical appliance 5, since each medical appliance 5 has stored in it its entire protocol and data. The storage of data inside the communication devices 6 for the case of power supply failures is no longer necessary as a result.

All the features disclosed in the application documents are claimed as being essential to the invention, insofar as they are novel either individually or in combination as compared with the prior art.

List of References

1, 2, 3, 4	data transmission stage
5, 5a	medical appliances
6	communication device
6a	memory unit
6b	control unit
7	first network
8	central server device
9	second network
10a - 10c	application operation units
11	third network
21 - 34	method steps
AS	application server unit
SS	memory unit

Claims

1. A system for controlling a data transmission to and/or from a plurality of medical appliances (5), wherein the plurality of medical appliances (5) are subdivided into individual groups (5a) with at least one medical appliance (5) in each case, characterized in that each group (5a) of medical appliances (5) on a first data transmission stage (1) is directly connected by way of a first network (7) in each case to a communication device (6) arranged on a second data transmission stage (2) for the transmission, storage and control of data, and means are provided which are designed in order that a plurality of these communication devices (6) may exchange data with a common central server device (8) arranged on a third data transmission stage (3) for the storage, control and transmission of data.
2. A system according to claim 1, characterized in that the means are a second network (9) which directly connects the communication devices (6) to the common central server device (8) arranged on the third data transmission stage (3).
3. A system according to claim 1, characterized in that the means constitute an external storage medium, such as a USB stick or a memory card.
4. A system according to claims 1 to 3, characterized in that the central server device (8) comprises an

application server unit (AS) and a memory server unit (SS), wherein the application server unit (AS) is connected to application operation units (10a, 10b, 10c) on a fourth data transmission stage (4) by means of a third network (11).

5. A system according to any one of the preceding claims, characterized in that each communication device (6) has at least one first memory unit (6a) and one first control unit (6b) in order to store temporarily data arriving and received from the medical appliances (5) of the group (5a), in particular appliance-specific and patient-specific data on patients who are connected up to the medical appliances (5), and to pass them on in a bundled manner to the memory server unit (SS).
6. A system according to claim 5, characterized in that the first memory unit (6a) and the first control unit (6b) of the communication device (6) are suitable for storing temporarily data arriving and received from the memory server unit (SS) or the application server unit (AS), in particular medicine-specific data, and to pass them on to selected medical appliances (5) upon demand or if required.
7. A system according to any one of the preceding claims 4 to 6, characterized in that the third network (11) connects the application operation units (10a, 10b, 10c) to the application server unit (AS) by means of a web interface and a web browser.
8. A system according to any one of the preceding claims, characterized in that the medical appliances (5) are

insulin pumps.

9. A method for controlling the transmission of data to and/or from a plurality of medical appliances (5), wherein the plurality of medical appliances (5) are subdivided into individual groups (5a) with at least one medical appliance (5) in each case, characterized in that each group (5a) of medical appliances (5) on a first data transmission stage transmits data from or to a communication device (6) arranged on a second data transmission stage (2) by way of a first network (7) in each case and controls them, and a plurality of these communication devices (6) transmit - by way of a second network (9) - data from or to a common central server device (8) arranged on a third data transmission stage (3) and control them.
10. A method according to claim 9, characterized in that the central server device (8) is provided with an application server unit (AS) and a memory server unit (SS), wherein the application server unit (AS) is connected to application operation units (10a, 10b, 10c) on a fourth data transmission stage (4) by way of a third network (11) and is operated, controlled and regulated also with respect to writing and reading data by the application operation units.
11. A method according to claims 9 and 10, characterized in that data which are received in at least one first memory unit (6a) and by means of a first control unit (6b) and which are transmitted by the medical appliances (5) of the group (5a), in particular appliance-specific and patient-specific data of patients who are connected up to the medical

appliances (5), are stored temporarily in each communication device (6) and are passed on in a bundled manner to the memory server unit (SS).

12. A method according to claim 11, characterized in that the first memory unit (6a) and the first control unit (6b) of the communication device (6) receive and temporarily store data, in particular medicine-specific data, from the memory server unit (SS) or the application server unit (AS) in order to pass them on to selected medical appliances (5) upon demand or if required.
13. A method according to any one of claims 9 to 12, characterized in that the first network is selected from the CAN type and the second and third networks are selected from the WLAN and/or LAN type.