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System for Automated Analysis and Optimization of Building Automation Systems

Field of the Invention

The invention relates to a system for automated analyses and optimization of building automation systems comprising at least one building control and several building systems controlled thereby, and to a corresponding method for controlling said system.

Background of the Invention

The energy consumption of buildings in developed countries is responsible for 40% of the total energy consumption and higher in the EU and the USA than the proportion of industrial energy consumption and that of the transportation sector. In this context, increasing energy efficiency and actively integrating buildings into an energy system of the future have enormous potential to help reduce energy consumption.

Intelligent meters (so called "smart meters") are already being integrated into building systems worldwide to record electricity or gas consumption over time and can display the actual energy consumption and actual usage time to the respective connection user and can be integrated into a communication network. Depending on the model, smart meters can automatically transmit the collected data to an energy supply company, for example, which should enable intelligent grid and resource management. Here, the electricity consumption for a large number of consumers can be managed, but these measures do not collect any information on the operating parameters of the respective systems operated, but merely control the time when such a consumer is connected to the grid in order to shift consumption to favorable consumption times at favorable consumption prices. Here, sensors for consumption monitoring can be integrated into the main electricity connection of the building and transfer the measured consumption data to a local evaluation unit. Provided with a signature that uniquely identifies the consumer, this data can be used for grid and consumption control, wherein the user can receive a user profile and, if necessary, specify

preferences for the user's energy consumption. Such real-time consumption management merely allows grid loads to be shifted to favorable time periods and a more even grid load to be achieved.

Here, it is not possible to use the smart meters to directly allocate energy consumption to specific devices or building systems unless said meters are arranged in the supply line for the corresponding device. If an allocation is desired, these allocations can currently only be made on the basis of measurements of the actual consumption curves of the relevant devices and building systems on site.

US 2015/094860 A1 discloses the use of a geo-limited perimeter for energy-efficient building control. The method and corresponding system associates mobile personal telecommunication devices of building occupants with the room and space they occupy in a building or other facility and generates instructions to a building automation system based on changes in the position of the mobile communication devices relative to the associated room or space.

EP 2 544 059 A1 discloses an energy source management control system and a corresponding method based on IT infrastructure provided by the Internet, the so-called cloud computing, comprising a territory controller for controlling the territory of each energy-consuming device according to user-defined parameters and for transmitting the user-defined parameters to a cloud computing management control platform; an energy consumption parameter collector for collecting parameters on energy consumption of each energy-consuming device and for transmitting the collected parameters to the cloud computing management control platform; and the cloud computing management control platform for adjusting a territory control mode according to the collected and user-defined parameters regarding the energy consumption of each energy-consuming device.

US 2012/70022700 A1 discloses a building control system of a building automation system for automated analysis and optimization of the building automation system comprising a plurality of building system which are connected to the building control by means of a data connection for control by the building

control, wherein a data module of the building control is connected to the building automation system in a suitable manner in order to automatically read in at least the building-related data of the building systems communicated in the building automation system between the building control and the building system and transmit the data to an analysis server. US 2016/0182247 A1 discloses a similar cloud-based system. WO 2016/094445 A1 discloses a system in which a window control unit communicates with at least one other system of a building automation system.

Due to the linkage of buildings, over 980 million measuring points will be installed in buildings by 2020, which corresponds to a data volume of 431,000 petabytes per year. Until now, it has not been possible with reasonable effort to analyse the data available in principle for optimized system control in such a way that, in addition to general energy management of the consumption time intervals, parameters in the system control can be identified that are not optimally set by the programmed building control, such as indoor temperature relative to outdoor temperature as a result of the heating control (thermostats, burner settings, flow temperatures) or other parameters for this or other building systems. A high presence of defects in building-related systems also leads to a fundamentally excessive energy consumption regardless of favorable consumption times in the electricity grid and to high maintenance costs for servicing the building systems. Furthermore, building energy systems are often unable to meet the requirements (thermal comfort, indoor air quality, and other energy services such as process heating and cooling). In order to gain knowledge of these parameters from the building control, detailed knowledge of the system programming is required, which is not yet possible without the cooperation of the respective system manufacturer. There are currently no tools available that are able to analyze the operating parameters regardless of the existing building control and regardless of the type and number of building systems controlled thereby and to check the quality of the locally implemented building control for its efficiency at all, let alone optimize it.

It is therefore desirable to have such a tool available in order to be able to easily reduce the operating costs or the maintenance effort for the building systems by improved building control.

Summary of the Invention

It is an object of the present invention to provide a tool to easily reduce the operating costs or the maintenance effort for the building systems by improved building control.

This object is achieved by a system for automated analysis and optimization of building automation systems comprising at least one building automation system with at least one building control and several building systems connected to the building control by means of a data connection for control by the building control, where a data module is subsequently connected to the respective already previously existing building automation system in a suitable manner in order to automatically read in at least the raw operating data of the building system communicated in the building automation system and transmit them to an analysis server, wherein the analysis server is provided, without further knowledge of the building control and the building system, to assign individual raw operating data to individual physical parameters and individual building systems from a total amount of the transmitted raw operating data using an analysis program executed on the analysis server, on the basis of which the quality of the control of the building systems by the building control system is checked.

Here, the term "building automation system" refers to the entirety of the building systems and building control systems that control the building systems in one or more buildings or in a building complex (property), as well as the data connections linking the individual systems or components of the building automation system. Here, the term "building" comprises all types of buildings including residential buildings, functional buildings, industrial plants, workshops etc. The term "building control" refers to the part of the building automation system by means of which the connected devices and systems are controlled. Here, the term "control" refers to both the control and regulation of building systems and includes the exchange of data between the control and systems in

both directions. The term "building system" refers to all systems of a building that are controlled by a building control and with which data is exchanged. Such building systems include, for example, building air conditioning systems, room air conditioning systems, heating systems, lighting systems and much more. The data connection between building control and building systems can be implemented as BUS systems such as BACnet/IP, LON/IP, KNX, BACnet/MSTP. The term "raw operating data" refers to all building-related data communicated in a building automation system between the building control and the building systems. The raw operating data can already include time information for the compilation of time series of measured values. In one embodiment, the data module provides the read-in raw operating data with a time stamp so as not to be dependent on the presence of time information in the raw operating data when evaluating the raw operating data. The time stamp indicates the time at which the raw operating data was read in. As the data is read in real time, the time stamp corresponds to the time at which the raw operating data contained the relevant data content. In this case, a data packet containing the raw operating data and the respective time stamp is transmitted to the analysis server. The raw operating data can be transmitted to the analysis server in any suitable way. In one embodiment, at least the raw operating data is transmitted to the analysis server via an Internet connection or a GSM/WLAN/radio connection or via a connection (7) via a double Ethernet. The wireless data transmission enables a very flexible use of the building automation system according to the invention and takes into account the security requirements of the operators of the building automation systems.

The system operators of building automation systems generally have no interest in disclosing the system behavior of the respective building automation system. One advantage of the system according to the invention is that the data module can be subsequently integrated into any locally available building automation systems without having to have system knowledge of the respective building automation system. The data module represents an IP connection established with suitable components to the building automation system with the fullest possible access to the IP subscribers in the building automation system, wherein access means reading in as much of the communicated data as possible. This

makes the data collection process scalable. In one embodiment, the data module can be implemented as a cloud solution, wherein the data module is granted access to the raw operating data of the building automation system by the building automation system. The operator of the building automation system can implement access by setting the appropriate access rights and so-called firewall settings, respectively. Once access has been enabled, the raw operating data is read in without installing a device driver and/or making settings on the building control system.

In an alternative embodiment, the data module is connected to the already previously existing data connection building automation system in a suitable manner in order to automatically read in at least the raw operating data of the building system communicated via the data connection. Here, the data module represents a subsequently inserted hardware component. In one embodiment, the data module is configured as a so-called plug-and-play component that can read in the raw operating data without the need to install device drivers and/or make settings on the building control system. The data module can be configured as an OPC communication interface, for example. The data module can be integrated into the communication network between building control and building systems, for example via BUS terminals and Ethernet/IP. In doing so, all data protocols currently in use can be read out automatically, starting with BACnet. The data module abstracts the data acquisition process as far as possible from the local data connection and the communication protocols of the building control. This enables manufacturer-independent data acquisition that does not depend on the specific building control available, but can be used for all building control systems that communicate with the building systems via data connections. Device-independent data acquisition with the data module means that larger properties that use different building automation systems with different building control systems for different building complexes can use the building automation system according to the invention to easily make their own data from all existing buildings available to them without having to deal with the technical design of the individual building automation systems, including the building control and building systems, in the system according to the invention.

The analysis by the analysis program is based on a so-called big data approach. Certain information is filtered out of the available data, which allows characteristics about the basic system operation. To enable data analysis without knowledge of the building control and the building systems, statistical methods and the so-called machine learning using random forests, bagged trees, hidden Markov models or support vector machines can be used to recognize patterns from large amounts of data, such as time series of certain type time series. The random forest method is a classification method that consists of several different, uncorrelated decision trees. All decision trees have grown under a certain type of randomization during the learning process. For a classification, each "tree" in this "forest" can make a decision and the class with the most votes decides the final classification. Bagged trees is a method for creating trees in order to combine predictions from different regression or classification models. The hidden Markov model is a stochastic model in which a system is modeled by a so-called Markov chain with unobserved states. A support vector machine is a classifier. A support vector machine divides a set of objects into classes in such a way that the widest possible area around the class boundaries remains free of objects; it is a so-called wide-edge classifier. Support vector machines can be used for both classification and regression and are not machines in the conventional sense, but a mathematical method of pattern recognition that can be implemented in computer programs, in this case the analysis program. Data pre-processing, such as frequency band filtering, model-based gap interpolation and outlier treatment of individual raw operating data, can precede the actual data analysis. In one embodiment, the transmitted raw operating data is categorized and classified by the analysis program according to its data structure and stored in corresponding time series in accordance with the respective categories and classifications. Here, the type classes of the time series (e.g. temperatures, target values, consumptions, set operating points, set system settings, pressure, output, humidity, alarm states, etc. from plausibility checks of the read-in values of the raw operating data) are first determined from many time series from today's building automation systems (order of magnitude, for example, 50 to 30,000 time series) and then components of the building systems are automatically recognized, for example correlating heat pumps, boilers, circulation pumps and so on, which generate these time series.

The physical parameters can clearly identify raw operating data in their time sequence, for example from temperature sensors in liquids, such as water, and in gases, such as air. Based on a cluster analysis of the temperatures, a distinction can be made between room temperatures, ambient temperatures, energy conversion machine temperatures, energy distribution temperatures and so on. This allows conclusions to be drawn about, for example, window openings, excessive room temperatures depending on the outside air temperature or excessive flow temperatures. These immediately provide information on where energy can be saved.

The analysis program is executed on an analysis server. Here, the term "analysis server" refers to the computer infrastructure (hardware and software) that provides the computer functionalities for operating the building automation system, in particular those for executing the analysis program and for data transmission with the data module and, if applicable, with the building control.

The existing building-related control loops in building automation systems have considerable potential for improvement, which can be made visible as a quality of the control with the building automation system according to the invention and the control loops can subsequently be optimized on the basis of the data analysis.

Buildings are currently passive "black box" consumers with rigid, non-dynamic energy consumption models. In principle, however, buildings, especially more complex buildings, offer a great deal of flexibility for adapting their energy consumption and, to some extent, their energy generation. Today, more complex building energy systems are provided with building automation. In Germany, there are around 1.8 million of such buildings. A plurality of data points are required to operate this building automation. Due to the plurality of data on the various systems of the building control system, the inherent complexity and technical barriers, there is currently no procedure for the holistic use of this data. The most advanced systems currently store at most a small selection of data points (e.g. trend curves). The information content available in the entirety of a system's data is not analyzed or used.

The availability of building-related data is not provided in a sufficient amount today. Data that is available in prior art building automation systems and contains a plurality of information is not used to improve energy efficiency due to the lack of a corresponding analysis and a corresponding analysis method, respectively. In many cases, retrofitting a conventional monitoring system is not possible or only possible at a very high cost.

The present invention, on the other hand, enables data acquisition and analysis of building-related data with low investment and ongoing operating costs, and with little personnel effort, wherein the information contained in the total amount is made available by means of evaluation and assignment and further actions can be derived therefrom. The system according to the invention thus enables both the automated analysis and the automated optimization of building automation systems. The present invention provides a tool with which the operating costs or maintenance costs for the building systems can be reduced in a simple manner by an improved building control.

In one embodiment, sample time series for a plurality of different building systems are stored in the building automation system, which the analysis program can access in order to determine a probability that a time series of raw operating data can be assigned to a specific building system on the basis of the sample time series. This assignment can be made by combining the above-mentioned statistical methods and so-called machine learning for classification and categorization of the raw operating data with technical knowledge in the form of sample time series. This means that the information contained in the raw operating data is automatically made available without any additional manual effort. This can speed up the computationally intensive process of data point mapping enormously. This involves analysing blank time series on the basis of statistical characteristics in conjunction with the use of sample time series (digitized expert knowledge). In one embodiment, the analysis program is configured to assign the time series of raw operating data to a specific building system if the probability determined for this time series exceeds a predefined threshold. The threshold prevents potentially incorrect assignments from being made automatically if the probability values are low.

In a further embodiment, the analysis program is configured to automatically create a system circuit diagram for the respective building control from the assigned building systems and to dynamically adapt it when further time series are assigned to building systems. The automatic building-related topology detection (the assignment of raw operating data to building systems verifies the presence of these building systems, which is referred to as topology detection) based on rule-based algorithms is used to recognize connections between individual components. A system topology of the respective relevant building complex can be identified therefrom as a system circuit diagram, enabling operational analyses at overall energy system level.

In one embodiment, the analysis program is configured to check a correlation with other value jumps in other time series in the event of a value jump in the raw operating data of a time series and, if a correlation is determined, to illustrate the assigned building systems as linked to one another in the system circuit diagram. Since the raw operating data is based on physical processes that can have an influence on other processes, such a cross-correlation check is an effective method of linking raw operating data and the assigned building systems.

In a further embodiment, at least the transmitted raw operating data is stored in a central cloud. A database is hosted in the central cloud, i.e. it is located on a web server, wherein the web server is operated by a trustworthy provider and thus the location of the cloud is determined. This database is accessed by the analysis program, the results of which are in turn stored in the database. Dynamic data keeping in the form of databases only makes sense for a limited time. In contrast, historicized data keeping in data containers such as HDF5 is much more efficient when it comes to closed data sets, for example for data dating back more than two years.

In a further embodiment, the analysis server is provided to transmit control commands to the building control on the basis of the analyzed raw operating data in order to optimize the control of the building systems. For this purpose, the analysis server must have a data connection with write access to the building

control. The person skilled in the art is able to implement such a data connection for building control. With the possibility of transmitting control commands to the building control, the operation of the building systems can be immediately automatically adjusted at any time based on the results of the analysis program. The preferred operating mode for these building systems can be stored in the building automation system according to the invention, for example in the form of so-called look-up tables, to which the analysis program and the analysis server have access. The analysis program can compare the actual raw operating data with the target raw operating data and transmit control commands to adjust the actual raw operating data to the target raw operating data.

Furthermore, the invention relates to a method for controlling a building automation system according to the invention comprising at least one building automation system with at least one building control and several building systems, which are connected to the building control by means of a data connection for control by the building control, the method comprising the following steps:

- subsequently connecting a data module to the respective already previously existing building automation system;
- automatically reading in raw operating data communicated in the building automation system by means of the data module;
- transmitting at least the read-in raw operating data from the data module to an analysis server;
- assigning individual raw operating data from the total amount of raw operating data to individual physical parameters and individual building systems by means of an analysis program executed on the analysis server without further knowledge of the building control and the building systems; and
- checking a quality of the control of the building system by the building control based on the assigned raw operating data.

In one embodiment, the method comprises the following further steps:

- providing the read-in raw operating data with a time stamp by the data module in order to form a data packet which is subsequently transmitted to the analysis server in the transmission step, and

- categorizing and classifying the transmitted raw operating data according to their data structure and storing the raw operating data in corresponding time series in accordance with the respective categories and classifications by means of the analysis program.

In a further embodiment, the method comprises the following further steps:

- accessing, by means of the analysis server, to sample time series stored in the building automation system for a plurality of different building systems;
- determining a probability for at least one of the time series of raw operating data by means of the sample time series that this time series is to be assigned to a specific building system; and
- assigning the time series of raw operating data to a specific building system by the analysis program, provided that the probability determined for this time series exceeds a predefined threshold.

In a further embodiment, the method comprises the following further steps:

- automatically creating a system circuit diagram for the respective building control from the assigned building systems; and
- dynamically adapting the system circuit diagram when further time series are assigned to building systems.

In a further embodiment, the method comprises the following further steps:

- checking, by the analysis program, whether there is a correlation with other value jumps in other time series in the event of a value jump in the raw operating data of a time series; and
- linking the building systems in the system circuit diagram assigned to the respective time series to each other if a correlation of the value jumps of the respective time series is determined.

In a further embodiment, the method comprises the further step of transmitting control commands to the building control based on the analyzed raw operating data to optimize the control of building systems by the analysis server.

Brief Description of Drawings

This and other aspects of the invention are shown in detail in the drawings as follows:

Fig. 1: an exemplary embodiment of a system for automated analysis and optimization of building automation systems according to the invention;

Fig. 2: another embodiment of a method according to the invention for controlling the system according to the invention of Fig. 1.

Detailed Description of the Exemplary Embodiments

Fig. 1 shows an exemplary embodiment of the system 10 according to the invention comprising a building automation system 1 with a building control 2 and three building systems 3, shown here as examples, which are connected to the building control 2 by means of a data connection 4 for control by the building control 2 and via which the raw operating data B are transmitted between the building control 2 and the building systems 3. Here, a data module 5 is subsequently connected to the already existing building automation system 1 in order to automatically read in at least the raw operating data B of the building systems 3 communicated in the building automation system 1. The data module represents an IP connection established with suitable components to the building automation system 1 with the fullest possible access to the IP subscribers (building control 2 and building systems 3) in the building automation system 1 for reading in all communicated data. The data module 5 can be implemented as a cloud solution (here only schematically shown), wherein an access of the data module 5 to the raw operating data of the building automation system 1 is granted by the building automation system 1. The operator of the building automation system 1 can implement access by setting the appropriate access rights and so-called firewall settings, respectively. However, the data module 5 can also be connected directly or indirectly as a hardware component to the already previously existing data connection 4 of the building automation system 1 in order to automatically read in the raw operating data of the building systems 3 communicated via the data connection 4. Here, the data module 5 can be configured as a so-called plug-and-play component that can read in the

raw operating data B without the need to install device drivers and/or make settings on the building control system 2.

In addition, in the embodiment shown in Fig. 1, the data module 5 provides the read-in raw operating data B with a time stamp Z to form a data packet DBZ. After reading in, the corresponding data packets DBZ with time stamp Z are transmitted to an analysis server 6. The transmission to the analysis server 6 is preferably carried out via an Internet connection 7 or GSM/WLAN/radio connection 7 or via a connection 7 via a double Ethernet. Without further knowledge of the building control 2 and the building systems 3, the analysis server 6 then assigns individual raw operating data B to individual physical parameters and to individual building systems 3 from a total amount of the transmitted raw operating data B using an analysis program 61 executed on the analysis server 6, on the basis of which the quality of the control of the building systems 3 by the building control 2 is checked. In doing so, the analysis program 61 categorizes and classifies the transmitted raw farm data B according to their data structure and stores the categorized and classified raw operating data B in corresponding time series ZR in accordance with the respective categories and classifications. Furthermore, the analysis program 61 can access sample time series MZR stored in the system 10 for a plurality of different building systems 3 and use the sample time series MZW to determine a probability W that a time series ZR of raw operating data B is to be assigned to a specific building system 3. In this embodiment, the analysis program 61 is configured to assign the time series ZR of raw operating data B to a specific building system 3, provided that the probability W determined for this time series ZR exceeds a predefined threshold SW. The analysis program 61 can also be configured to automatically create a system circuit diagram A for the respective building control 2 from the assigned building systems 3 (shown dashed) and to dynamically adapt it when further time series ZR are assigned to the building systems 3. Here, the analysis program 61 can check a correlation with other value jumps in other time series ZR in the event of a value jump in the raw operating data B of a time series ZR and, if a correlation is determined, illustrate the assigned building systems 3 as linked to one another in the system circuit diagram A. A correlation is considered to have been determined if the value jumps in different time series occur several

times at the same time interval. In this embodiment, the transmitted raw operating data B, the data packets DBZ, the time series ZR of raw operating data B, and the sample time series MZR are stored in a central cloud 8. Furthermore, the analysis server 6 can be provided to transmit control commands SB to the building control 2 based on the analyzed raw operating data B (shown dashed) in order to optimize the control of the building systems 3.

Fig. 2 shows a further embodiment of a method according to the invention for controlling the system according to the invention of Fig. 1, comprising the steps of subsequently connecting 110 a data module 5 to the respective already previously existing building automation system 1 in a suitable manner; automatically reading in 120 raw operating data B communicated in the building automation system 1 by means of the data module 5, wherein the read-in raw operating data B are provided with a time stamp Z by the data module 5 in order to form a data packet DBZ; transmitting 130 at least the read-in raw operating data B or the data packet DBZ from the data module 5 to an analysis server 6; assigning 140 individual raw operating data B from the total amount of raw operating data B to individual physical parameters and individual building systems 3 by an analysis program 61 executed on the analysis server 6 without further knowledge of the building control 2 and the building systems 3, which in this embodiment comprises the steps of categorizing and classifying 142 the transmitted raw operating data B according to their data structure and storing 144 the raw operating data B in corresponding time series ZR in accordance with the respective categories and classifications by means of the analysis program 61; accessing 145, by means of the analysis server 6, sample time series MZR stored in the building automation system 1 for a plurality of different building systems 3; determining 147 a probability W for at least one of the time series ZR of raw operating data B based on the sample time series MZR that said time series ZR is to be assigned to a specific building system 3; and assigning 149 the time series ZR of raw operating data B to a specific building system 3 by means of the analysis program 61 if the probability W determined for this time series ZR exceeds a predefined threshold value SW; followed by the step of checking 150 a quality of the control of the building systems 3 by the building control 2 based on the assigned raw operating data B. The method

can additionally include the step of automatically creating 160 a system circuit diagram for the respective building control 2 from the assigned building systems 3, comprising the steps of checking 162, by means of the analysis program 61, whether a value jump in the raw operating data B of a time series ZR is correlated with other value jumps in other time series ZR, and of linking 164 the building systems 3 assigned to the respective time series ZR in the system circuit diagram with each other if a correlation of the value jumps of the respective time series ZR is determined, followed by the step of dynamically adapting 170 the system circuit diagram when further time series ZR are assigned to the building systems 3. Furthermore, the method can comprise the step of transmitting 180 control commands SB to the building control 2 based on the analyzed raw operating data B to optimize the control of the building systems 3 by the analysis server 6.

List of Reference Numerals

1	building automation system
2	building control
5 3	building system
4	data connection between building control and building systems
5	data module
6	analysis server
61	analysis program
10 7	connection between data module and analysis server
8	central cloud
10	system for automated analysis and optimization of building automation systems according to the invention
100	method for controlling the building automation system according to the invention
110	subsequently connecting a data module (5) to the already existing data connection
120	reading in raw operating data by means of the data module
125	providing the raw operating data with a time stamp to form a data packet
130	transmitting the raw operating data from the data module to the analysis server
140	assigning individual raw operating data to individual physical parameters and individual building systems
142	categorizing and classifying the transmitted raw operating data according to their data structure
144	storing the raw operating data in corresponding time series in accordance with the respective categories and classifications
145	accessing stored sample time series
147	determining a probability by means of the sample time series that a time series is to be assigned to a specific building system
149	assigning the time series to a specific building system, provided that the determined probability exceeds a predefined threshold
150	checking a quality of the control of the building systems

160	automatically creating a system circuit diagram for the respective building control
162	checking whether value jump in a time series correlates with other value jumps in other time series
164	linking the building systems in the system circuit diagram assigned to the respective time series to each other if a correlation is determined
170	dynamically adapting the system circuit diagram when further time series are assigned to building systems
180	transmitting control commands to the building control based on the analyzed raw operating data to optimize the control of building systems

A	system circuit diagram
B	raw operating data
DBZ	data packet comprising time stamp and raw operating data
MZR	sample time series
SB	control command to the building control
SW	predefined threshold
W	probability that a time series of raw operating data is to be assigned to a building system
Z	time stamp
ZR	time series of raw operating data

Patentkrav

1. System (10) til automatiseret analyse og optimering af bygningsautomatiseringssystemer (1), omfattende mindst et bygningsautomationssystem (1) med mindst en bygningsstyring (2) og flere bygningsanlæg (3), der er forbundet med bygningsstyringen (2) ved hjælp af en dataforbindelse (4) til styring gennem bygningsstyringen (2), hvor et datamodul (5) passende er forbundet med det respektive allerede eksisterende bygningsautomatiseringssystem (1) for automatisk at indlæse alle tekniske bygningsdata, der er kommunikeret mellem bygningsstyring og bygningsanlæg, i bygningsautomatiseringssystemet (1) som rå driftsdata (B) for bygningsanlæggene (3), og overføre dem til en analyseserver (6), hvor analyseserveren (6) er tilvejebragt for at tildele individuelle rå driftsdata (B) til individuelle fysiske parametre og individuelle bygningsanlæg (3) ved hjælp af en Big Data-tilgang uden yderligere kendskab til bygningsstyringen (2) og bygningsanlæggene (3) fra en samlet mængde af de rå driftsdata (B), der er transmitteret af datamodulet (5) ved at bruge et analyseprogram (61), der udføres på analyseserveren (6), hvor der i Big Data-tilgangen fra de tilgængelige data filtreres visse oplysninger, der gør det muligt at udtale sig om egenskaberne ved den grundlæggende anlægsdrift, og analyseprogrammet (61) kategoriserer, klassificerer og lagrer de rå driftsdata (6) efter deres datastruktur i tilsvarende tidsserier (ZR) i overensstemmelse med de respektive kategorier og klassifikationer, hvor analyseprogrammet (61) først bestemmer en typeklasse af tidsserien ud fra en flerhed af tidsserier af kendte bygningsautomatiseringssystemer, og hvor analyseprogrammet (61) anvender tidsinformation, der er til stede i de rå driftsdata, eller et tidsstempel (Z), med hvilket datamodulet (5) leverer de indlæste rå driftsdata (BR), til kompileringen af tidsserien (ZR), hvor datamodulet (5) transmitterer tidsstemplet (Z) sammen med de rå driftsdata (B) som en datapakke (DBZ) til analyseserveren (6), og hvor systemet (10) er udformet til at optimere bygningstekniske styrekredsløb baseret på de rå driftsdata, der er analyseret af analyseprogram-

met (61), hvor analyseserveren (6) er tilvejebragt til at transmittere styrekommandoer (SB) til bygningsstyringen (2) baseret på de analyserede rå driftsdata (B) for at optimere styringen af bygningsanlæggene (3), og hvor typeklasser af tidsserier bestemmes ud fra kendte tidsserier for bygningsautomatiseringssystemer, hvor der er målværdier blandt de bestemte typeklasser, og hvor analyseprogrammet (61) sammenligner de faktiske rå driftsdata (B) med de ønskede rå driftsdata, og styrekommandoerne transmitteres for at tilpasse de faktiske rå driftsdata til de ønskede rå driftsdata.

2. System (10) ifølge krav 1,
kendetegnet ved, at
der i systemet (10) for en flerhed af forskellige bygningsanlæg (3) er lagret prøvetidsserier (MZR), som kan tilgås af analyseprogrammet (61), for ved hjælp af prøvetidsserierne (MZW) at bestemme en sandsynlighed (W) for, at en tidsserie (ZR) af rå driftsdata (B) skal tildeles et specifikt bygningsanlæg (3).

3. System (10) ifølge krav 2,
kendetegnet ved, at
analyseprogrammet (61) er udformet til at tildele tidsserien (ZR) af rå driftsdata (B) til et specifikt bygningsanlæg (3), forudsat at den sandsynlighed (W), der er bestemt for denne tidsserie (ZR), overstiger en foruddefineret tærskelværdi (SW).

4. System (10) ifølge krav 3,
kendetegnet ved, at
analyseprogrammet (61) er udformet til automatisk at oprette et anlægskredsløbsdiagram (A) for den respektive bygningsstyring (2) fra de tildelte bygningsanlæg (3) og til dynamisk at tilpasse det, når yderligere tidsserier (ZR) tildeles bygningsanlæg (3),

hvor analyseprogrammet (61) fortrinsvis er udformet til at kontrollere en sammenhæng med andre værdispring i andre tidsserier (ZR) i tilfælde af et værdispring i de rå driftsdata (B) af en tidsserie (ZR) og til, hvis der konstateres en sammenhæng, at vise de tildelte bygningsanlæg (3) som indbyrdes forbundne i anlægskredsløbsdiagrammet (A).

5. System (10) ifølge et hvilket som helst af de foregående krav, **kendetegnet ved, at**
transmissionen af mindst de rå driftsdata (B) til analyseserveren (6) sker ved hjælp af en internetforbindelse (7) eller en GSM/WLAN/radioforbindelse (7) eller en forbindelse (7) via dobbelt Ethernet, hvor de transmitterede rå driftsdata (B) fortrinsvis er lagret i en central sky (8).

6. System (10) ifølge et hvilket som helst af de foregående krav, **kendetegnet ved, at**
datamodulet (5) er implementeret som en cloud-løsning, hvor en adgang af datamodulet (5) til bygningsautomationssystemets (1) rå driftsdata gives af bygningsautomationssystemet (1),
eller
at datamodulet (5) er passende forbundet med den allerede tidligere eksisterende dataforbindelse (4) i bygningsautomatiseringssystemet (1) for automatisk at indlæse i det mindste de rå driftsdata (B) for bygningsanlæggene (3), der er kommunikeret via dataforbindelsen (4).

7. Fremgangsmåde (100) til styring af et system (10) ifølge krav 1, omfattende mindst et bygningsautomatiseringssystem (1) med mindst en bygningsstyring (2) og flere bygningsanlæg (3), der er forbundet med bygningsstyringen (2) ved hjælp af en dataforbindelse (4) til styring af bygningsstyringen (2), omfattende følgende trin:
- passende forbindelse (110) af et datamodul (5) med det respektive allerede eksisterende bygningsautomatiseringssystem (1);

- automatisk indlæsning (120) af alle tekniske bygningsdata som rå driftsdata (B), der kommunikeres i bygningsautomatiseringssystemet (1) mellem bygningsstyringen og bygningsanlæggene ved hjælp af datamodulet (5);
- transmission (130) af de indlæste rå driftsdata (B) fra datamodulet (5) til en analyseserver (6);
- tildeling (140) af individuelle rå driftsdata (B) fra den samlede mængde af rå driftsdata (B) til individuelle fysiske parametre og individuelle bygningsanlæg (3) ved hjælp af en Big Data-tilgang gennem et analyseprogram (61), der udføres på analyseserveren (6), uden yderligere kendskab til bygningsstyringen (2) og bygningsanlæggene (3), hvor der i Big Data-tilgangen fra de tilgængelige data filtreres visse oplysninger, der gør det muligt at udtale sig om egenskaberne ved den grundlæggende anlægsdrift, og de rå driftsdata (6) kategoriseres, klassificeres og lagrer efter deres datastruktur i tilsvarende tidsserier i overensstemmelse med de respektive kategorier og klassifikationer gennem analyseprogrammet (61), hvor der først bestemmes typeklasser af tidserierne ud fra en flerhed af tidsserier af kendte bygningsautomatiseringssystemer, hvor der er målværdier blandt de bestemte typeklasser, og hvor tidsinformation, der er til stede i de rå driftsdata (B), eller et tidsstempel (Z), hvormed datamodulet (5) leverer de indlæste rå driftsdata (BR), bruges eller bruges til kompilering af tidsserien (ZR), hvor datamodulet (5) transmitterer tidsstemplet (Z) sammen med de rå driftsdata (B) som en datapakke (DBZ) til analyseserveren (6); og
- optimering af byggetekniske styrekredsløb baseret på de rå driftsdata, der analysere af analyseprogrammet (61),
- omfattende det yderligere trin med transmission (180) af kontrolkommandoer (SB) til bygningsstyringen (2) baseret på de analyserede rå driftsdata (B) for at optimere styringen af bygningsanlæggene (3) gennem analyseserveren (6), hvor analyseprogrammet (61) sammenligner de faktiske rå driftsdata (B) med de ønskede rå driftsdata, og styrekommandoerne transmitteres for at tilpasse de faktiske rå driftsdata til de ønskede rå driftsdata.

8. Fremgangsmåde (100) ifølge krav 7, omfattende følgende yderligere trin:
- at forsyne (125) af de indlæste rå driftsdata (B) med et tidsstempel (Z) gennem datamodulet (5) for at danne en datapakke (DBZ), som efterfølgende transmitteres til analyseserveren (6) i transmissionstrinnet (120).

9. Fremgangsmåde (100) ifølge krav 8, omfattende følgende yderligere trin:
- adgang (145) af analyseserveren (6) til prøvetidsserier (MZR), der er lagret i systemet (10) for en flerhed af forskellige bygningsanlæg (3);
- bestemmelse (147) af en sandsynlighed (W) for mindst én af tidsserierne (ZR) af rå driftsdata (B) ved hjælp af prøvetidsserien (MZR), at denne tidsserie (ZR) skal tildeles til et specifikt byggeanlæg (3); og
- tildeling (149) af tidsserien (ZR) af rå driftsdata (B) til et specifikt bygningsanlæg (3) gennem analyseprogrammet (61), forudsat at sandsynligheden (W), der er bestemt for denne tidsserie (ZR), overskrider en foruddefineret tærskel (SW).

10. Fremgangsmåde (100) ifølge krav 9, omfattende følgende yderligere trin:
- automatisk oprettelse (160) af et anlægskredsløbsdiagram for den respektive bygningsstyring (2) fra de tildelte bygningsanlæg (3); og
- dynamisk tilpasning (170) af anlægskredsløbsdiagrammet, når yderligere tidsserier (ZR) tildeles bygningsanlæggene (3).

11. Fremgangsmåde (100) ifølge krav 10, omfattende følgende yderligere trin:
- at kontrollere (162) ved hjælp af analyseprogrammet (61), om der er en sammenhæng med andre værdispring i andre tidsserier (ZR) i tilfælde af et værdispring i de rå driftsdata (B) i en tidsserie (ZR); og
- at forbinde (164) bygningsanlæggene (3) i anlægskredsløbsdiagrammet, der er tildelt den respektive tidsserie (ZR), til hinanden, hvis en sammenhæng af værdispringene for den respektive tidsserie (ZR) bestemmes.

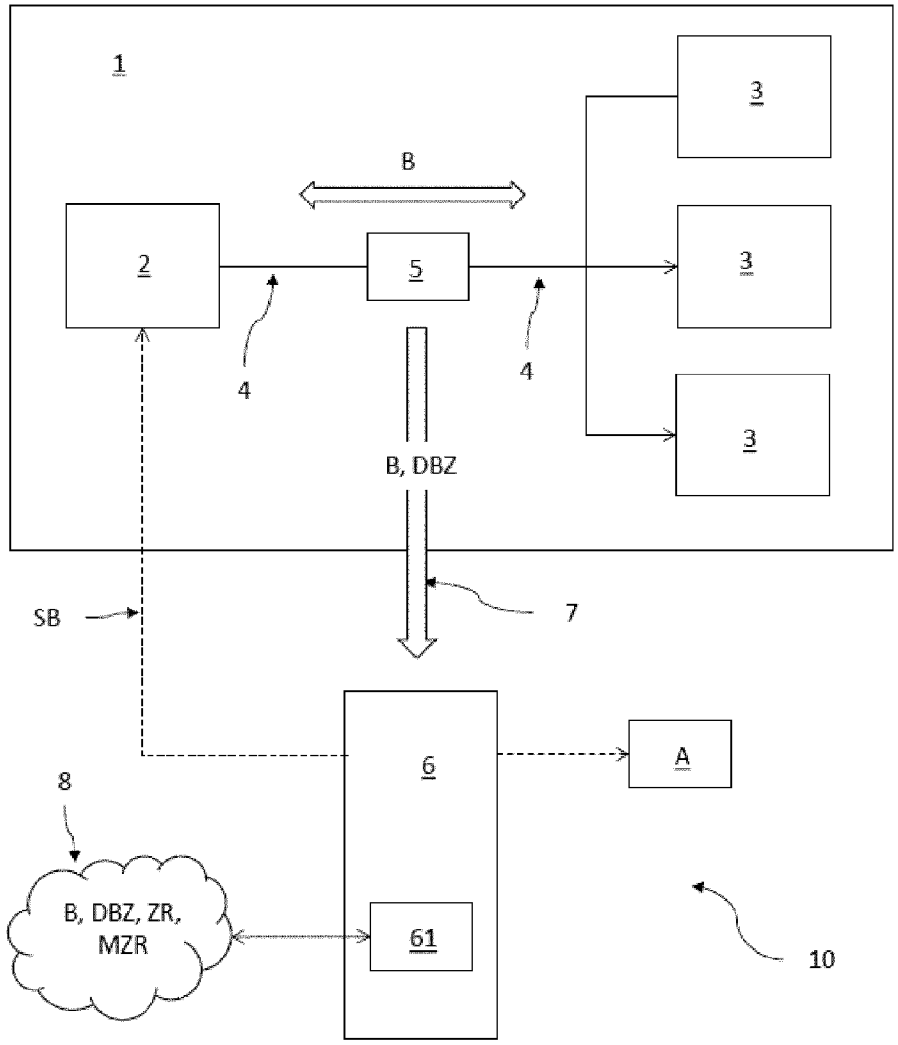


FIG.1

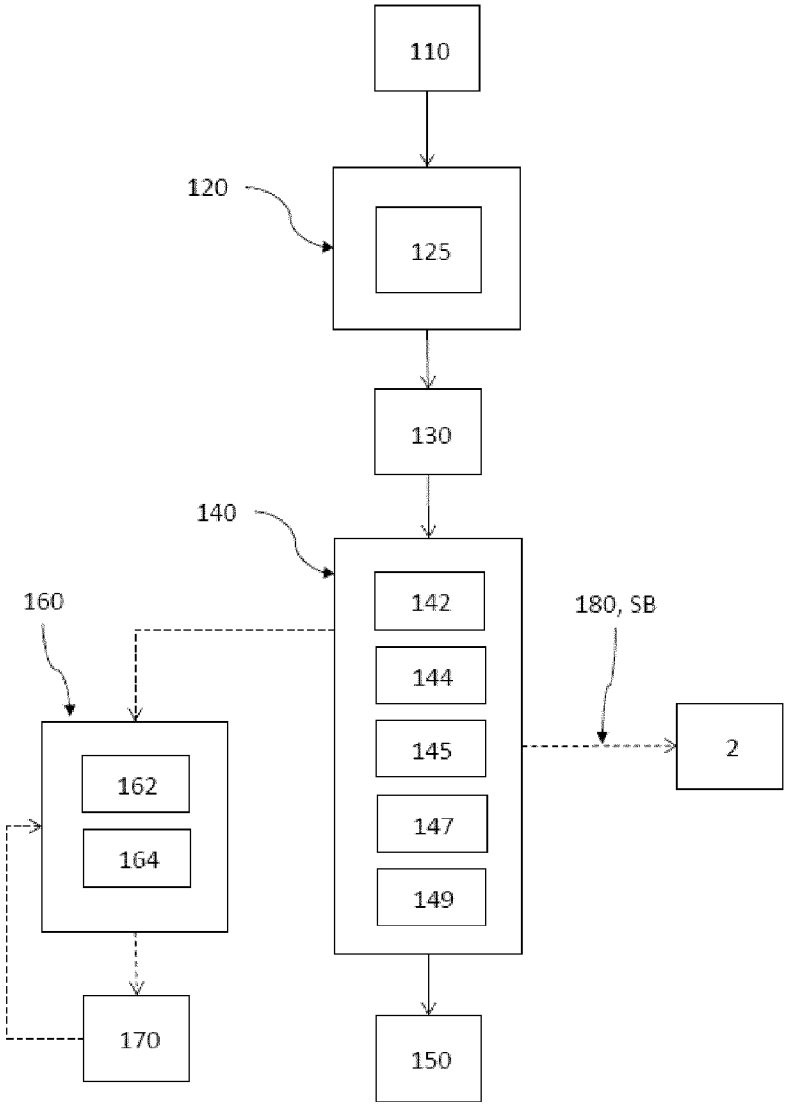

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FIG.2