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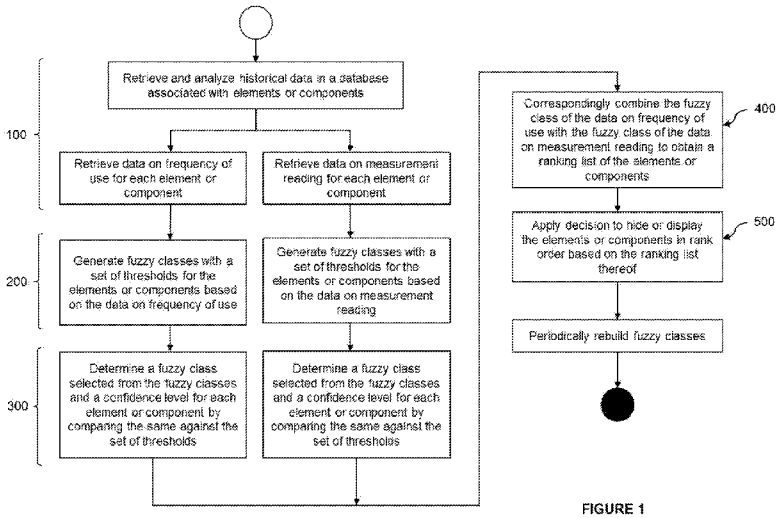

FIGURE 1

(57) Abstract: The present invention discloses a method for identifying and ranking elements or components present in a computing environment with limited resources using a customizable staggered filtering approach. The method comprises steps of retrieving and analyzing historical data including data on frequency of use and measurement reading from database (100); generating fuzzy classes with a set of thresholds (200); determining fuzzy class and confidence level by way of comparing the data on frequency of use and the data on measurement reading of the elements or components against the set of thresholds (300); and correspondingly combining the fuzzy class of the data on frequency of use with the fuzzy class of the data on measurement reading to obtain a ranking list according to combination metric defined for each fuzzy class combination (400).

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IDENTIFICATION, RANKING AND DISPLAYING OF ELEMENTS OR COMPONENTS IN COMPUTING ENVIRONMENT WITH LIMITED RESOURCES

FIELD OF THE INVENTION

The present invention relates generally to management and organization of elements or components in a computer system. More particularly, the present invention relates to a method for identifying and ranking elements or components present in a computing environment with limited resources using a customizable staggered filtering approach.

BACKGROUND OF THE INVENTION

Generally, an information computer system is a group of procedures and different elements that work together in order to complete a task including to generate information for the users on a need basis. The information computer system manages and processes data in many different types of forms and formats as soon as they have been created. Structured information is typically data found in database or spreadsheet formats or stored in self-defining formats wherein the information is managed by a dedicated software application.

As computer systems become larger, the number of peripheral devices constituting each system increases so that it becomes difficult to organize an enormous amount of data including elements or components for the system maintenance. Accordingly, there are too many elements or components in a particular system to be displayed, monitored and managed by a single user, e.g. maintenance engineer, and thus increasing the burden on the individual. In an environment with limited resources, the monitoring process of the elements or components can be compromised which leads to deficiency and incapability of the graphical user interface (GUI) to properly display all of these elements or components for the user. At the same time, the elements or components under monitoring are of critical in nature and thus they cannot be neglected or abandoned. The criticality of elements or components varies from case to case depending on the situation. Prior determination of the criticality of elements or components including simple filtering of the data appears to be not appropriate

and not workable. Moreover, simple filtering and ranking of elements or components is not an effective and insufficient process in view of the large number of elements or components contained within a large computer system.

Under this situation, to efficiently and adequately monitor, manage and organize the elements or components present in information computer systems, there are demands for the identification and ranking of these elements or components based on criticality as much as possible and for the display of the elements or components in rank order when a need arises although the information files may be searched and indexed.

Numerous attempts have been made heretofore to tackle these problems. For example, by way of background, United States Patent No. 6,701,312 B2 (hereinafter "the '312 patent") discloses a method for searching a document database such as the Internet and ranking the results obtained from such a search. According to the '312 patent, the mechanism also relates to ranking of a set of numerical data according to a set of user specified preferences, including target range, fuzziness and bias. A fuzzy score, in the '312 patent, is calculated for each database record satisfying a query and the results obtained is ranked according to the fuzzy score. The fuzzy score is calculated using a Lorentzian fuzzy score formula.

The problems however have never been addressed sufficiently by prior attempts and consequently, there still exists a need for a method for identifying and ranking elements or components present in a computing environment with limited resources thereby overcoming the problems and shortcomings of the prior art.

SUMMARY OF THE INVENTION

The following presents a simplified summary of the invention in order to provide a basic understanding of some aspects of the invention. This summary is not an extensive overview of the invention. Its sole purpose is to present some concepts of the invention in a simplified form as a prelude to the more detailed description that is presented later.

Accordingly, the present invention provides a method of ranking elements or components in a computing environment with limited resources.

The method of the present invention can be characterized by the steps of retrieving and analyzing historical data from a database associated with the elements or components, wherein the historical data includes data on frequency of use and data on measurement reading for each of the elements or components; for each of the data on frequency of use and the data on measurement reading, generating fuzzy classes with a set of thresholds for the elements or components thereof, wherein the step of generating fuzzy classes comprises determining quartiles of the data on frequency of use and the data on measurement reading; and subjecting the data on frequency of use and the data on measurement reading to normalization to obtain a normalized range from 0 to 1; for each of the data on frequency of use and the data on measurement reading, determining, based on the normalized range, a fuzzy class assigned based on the fuzzy classes generated thereof and a confidence level for each of the elements or components by way of comparing the data on frequency of use and the data on measurement reading of the elements or components against the set of thresholds; and for each of the elements or components, correspondingly combining the fuzzy class of the data on frequency of use with the fuzzy class of the data on measurement reading to obtain a ranking list of the elements or components, wherein the ranking list orderly ranks the elements or components according to a combination metric defined for each fuzzy class combination of the fuzzy class of the data on frequency of use and the fuzzy class of the data on measurement reading.

Preferably, the method comprises the step of dividing the elements or components thereof into a plurality of groups.

Preferably, the method comprises the step of assigning a numerical range for the elements or components retrieved thereof.

Preferably, the step of determining quartiles includes determining a first quartile, a second quartile and a third quartile.

Preferably, the fuzzy classes comprise a low fuzzy class, a medium fuzzy class and a high fuzzy class.

Preferably, the method further comprises the step of displaying the elements or components in rank order based on the ranking list thereof.

Preferably, the method further comprises the step of developing a combination metric based on fuzzy class combinations of the elements or components.

In accordance with another aspect, the present invention provides a non-transitory computer readable medium comprising a plurality of computer executable instructions that, in response to a user request, executes a method. The method comprising the steps of retrieving and analyzing historical data from a database associated with the elements or components, wherein the historical data includes data on frequency of use and data on measurement reading for each of the elements or components; for each of the data on frequency of use and the data on measurement reading, generating fuzzy classes with a set of thresholds for the elements or components thereof, wherein the step of generating fuzzy classes comprises determining quartiles of the data on frequency of use and the data on measurement reading; and subjecting the data on frequency of use and the data on measurement reading to normalization to obtain a normalized range from 0 to 1; for each of the data on frequency of use and the data on measurement reading, determining, based on the normalized range, a fuzzy class assigned based on the fuzzy classes generated thereof and a confidence level for each of the elements or components by way of comparing the data on frequency of use and the data on measurement reading of the elements or components against the set of thresholds; and for each of the elements or components, correspondingly combining the fuzzy class of the data on frequency of use with the fuzzy class of the data on measurement reading to obtain a ranking list of the elements or components, wherein the ranking list ranks the elements or components according to a combination metric defined for each fuzzy class combination of the fuzzy class of the data on frequency of use and the fuzzy class of the data on measurement reading.

It is an objective of the present invention to provide an improved method for dynamically determining criticality of elements or components present in a computing environment using fuzzy logic classification and for marking and flagging the elements or components based on the resulting ranking list. The present invention employs an effective use of display memory by way of not necessarily displaying all elements or components while the monitoring is still active. The present invention further employs an effective way of staggering, filtering and ranking a large number of elements or components within the system.

The foregoing and other objects, features, aspects and advantages of the present invention will become better understood from a careful reading of a detailed description provided herein below with appropriate reference to the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

A more complete appreciation of the invention and many of the attendant advantages thereof will be readily as the same becomes better understood by reference to the following detailed description when considered in connection with the accompanying drawings, wherein:

Figure 1 is a flow diagram of a method depicting steps of ranking elements or components in a computing environment with limited resources according to one embodiment of the present invention;

Figure 2 illustrates the step of, for the data on measurement reading, generating fuzzy classes with a set of thresholds for the elements or components thereof and the step of dividing the elements or components thereof into a plurality of groups or classes according to one embodiment of the present invention;

Figure 3a illustrates the step of determining quartiles of the data on measurement reading for Group A and Group B of the elements or components according to one embodiment of the present invention;

Figure 3b illustrates the step of subjecting the data on measurement reading to normalization to obtain a normalized range from 0 to 1 for Group A and Group B of the elements or components according to one embodiment of the present invention;

Figure 4a illustrates, for the data on measurement reading, the step of determining, based on the normalized range, a fuzzy class assigned based on the fuzzy classes generated thereof and a confidence level for each of the elements or components in Group A by way of comparing the data on measurement reading of the elements or components against the set of thresholds according to one embodiment of the present invention;

Figure 4b illustrates, for the data on measurement reading, the step of determining, based on the normalized range, a fuzzy class assigned based on the fuzzy classes generated thereof and a confidence level for each of the elements or components in Group B by way of comparing the data on measurement reading of the elements or components against the set of thresholds according to one embodiment of the present invention;

Figure 5a illustrates the step of determining quartiles of the data on frequency of use for Group A and Group B of the elements or components according to one embodiment of the present invention;

Figure 5b illustrates the step of subjecting the data on frequency of use to normalization to obtain a normalized range from 0 to 1 for Group A and Group B of the elements or components according to one embodiment of the present invention;

Figure 6a illustrates, for the data on frequency of use, the step of determining, based on the normalized range, a fuzzy class assigned based on the fuzzy classes generated thereof and a confidence level for each of the elements or components in Group A by way of comparing the data on frequency of use of the elements or components against the set of thresholds according to one embodiment of the present invention;

Figure 6b illustrates, for the data on frequency of use, the step of determining, based on the normalized range, a fuzzy class assigned based on the fuzzy classes generated thereof and a confidence level for each of the elements or components in Group B by way of comparing the data on frequency of use of the elements or components against the set of thresholds according to one embodiment of the present invention; and

Figure 7 illustrates the step of, for each of the elements or components, correspondingly combining the fuzzy class of the data on frequency of use with the fuzzy class of the data on measurement reading to obtain a ranking list of the elements or components according to one embodiment of the present invention.

It is noted that the drawings may not be to scale. The drawings are intended to depict only typical aspects of the invention, and therefore should not be considered as limiting the scope of the invention. In the drawings, like numberings represent like elements between the drawings.

DETAILED DESCRIPTION OF THE INVENTION

According to one preferred embodiment, the present invention provides a method of ranking elements or components in a computing environment or system, especially those with limited resources (e.g. memory, processing power, etc.), in a dynamic manner. The method preferably employs fuzzy logic classification which processes historical data, effective display memory usage and customizable staggered filtering in the steps outlined therein in order to determine criticality of each element or component present in the computing environment. Large scale resources such as memory are needed for performing large scale monitoring.

In the present invention, the elements or components are data available in the computing environment. They are stored in a database according to various classes or super classes, groups, individuals. The database containing these elements or components is preferably connected to a computer server. The computer server is a system on a network that provides a service to other systems connected to the network. The computer server monitors the elements or

components within the network and it can be used to acquire particular information for completing a task associated with the elements or components. A monitoring process is preferably done by a user, e.g. maintenance engineer, via a front-end graphical user interface (GUI).

The method of the present invention comprises a number of steps as shown in Figure 1. The method begins with the step **100** of retrieving and analyzing historical data from the database associated with the elements or components under monitoring. The historical data obtained from the database is preferably relating to the elements or components under monitoring. The historical data includes, but not limited to, data on frequency of use and data on measurement reading for each of the elements or components. Other historical data covered within the scope of the present invention can be used. In this regard, the step **100** preferably includes the step of retrieving and analyzing the data on frequency of use and the data on measurement reading for each of the elements or components. From this step **100** onwards, a historical data processing in the following steps shall be made in a separate and individual manner in accordance with the type of historical data they deal with.

Following that, the step **200** of generating fuzzy classes with a set of thresholds for the elements or components thereof is initiated. Preferably, the step **200** is executed for each of the data on frequency of use and the data on measurement reading. In the step **200**, it is preferred that the elements or components are assigned with a numerical range. The numerical range for the elements or components, for instance, can range from 1 (min) to 11 (max). The step **200** preferably comprises the sub-step of determining quartiles of the data on frequency of use and the data on measurement reading. The sub-step of determining quartiles preferably includes determining a first quartile (1st quartile), a second quartile (2nd quartile) and a third quartile (3rd quartile).The step **200** preferably further comprises the sub-step of subjecting the data on frequency of use and the data on measurement reading to normalization to obtain a normalized range from 0 to 1 (i.e. a linear relationship). Under the normalization operation, the numerical values assigned to the elements or components are adjusted to a notionally common scale, i.e. the normalized range from 0 to 1, prior to the next stage of processing. The fuzzy classes developed in the step **200** comprises a low

fuzzy class (hereinafter “LO fuzzy class”), a medium fuzzy class (hereinafter “MED fuzzy class”) and a high fuzzy class (hereinafter “HI fuzzy class”).

Subsequently, the method of the present invention executes the step **300**. The step **300** preferably involves, for each of the data on frequency of use and the data on measurement reading, determining, based on the normalized range from 0 to 1 generated in the step **200**, a fuzzy class and a confidence level for each of the elements or components. The fuzzy class is preferably assigned based on the fuzzy classes generated thereof in the step **200**. The determination of the fuzzy class and confidence level is made by way of comparing the data on frequency of use and the data on measurement reading of the elements or components against the set of thresholds developed together with the fuzzy classes in the preceding step **200**.

In the next step **400** of the method in the present invention, there involves combination or unification of the fuzzy classes that have been assigned to each of the elements or components in the step **300**. Particularly, the step **400** correspondingly combines the fuzzy class of the data on frequency of use with the fuzzy class of the data on measurement reading to obtain a ranking list of the elements or components. The ranking list orderly ranks the elements or components under monitoring according to a combination metric defined for each fuzzy class combination of the fuzzy class of the data on frequency of use and the fuzzy class of the data on measurement reading. For instance, one fuzzy class combination (that comprises one corresponding fuzzy class of the data on frequency of use and one corresponding fuzzy class of the data on measurement reading from the same element or component or the same group or class of elements or components) is allocated with one combination metric which comes with a predefined priority value so that the particular element or component or the particular group or class of elements or components can be orderly arranged in rank order of the ranking list. The combination metric is developed based on the fuzzy class combinations thereof.

Once the ranking list with the elements or components orderly ranked is obtained, a decision to hide or display the elements or components appearing on the ranking list is applied or implemented in the step **500**. In this regard, the user

is allowed to select for viewing the elements or components based on the group or class of elements or components and the ranks associated thereof – where only selected elements or components based on criticality as arranged in the ranking list are displayed to the user.

The method of the present invention preferably continues to periodically rebuild fuzzy classes as discussed in the step **200**.

In accordance with another embodiment of the present invention, prior to the step **100**, the elements or components under monitoring may be divided into a plurality of groups or classes. Each of the plurality of groups or classes of elements or components shall undergo substantially identical processes as described by the steps in the preceding paragraphs.

Other detail steps can be acquired based on above-mentioned embodiments, thus are omitted for brevity here.

Another aspect of the present invention includes a computer-readable medium that is non-transitory and may store instructions for performing the above-described method and any steps thereof, including any combinations of same. The non-transitory computer-readable medium may be an optical disc or a hard disk. However, the above-mentioned method is not limited to be performed via above-mentioned non-transitory computer-readable medium.

The present invention will now be described by way of following non-limiting examples, with reference to Figures 2 to 7 of the accompanying drawings.

Figure 2 illustrates the step **200** of generating fuzzy classes with a set of thresholds for the elements or components thereof in respect of the data on measurement reading. The table shown in Figure 2 depicts elements or components for temperature readings by devices which are grouped together. The elements or components tabulated thereof are assigned with a numerical range from 1 (min) to 11 (max). This figure further illustrates the step of dividing the elements or components thereof into a plurality of groups or classes. In this regard, the elements or components are divided into two groups, namely Group A

and Group B. Group A of elements or components contains the numerical range from 0 to 9. Group B of elements or components contains the numerical range from 1 to 11.

In Figure 3a which is part of the step **200**, the elements or components are arranged for determining quartiles of the data on measurement reading (i.e. temperature readings) for Group A and Group B. Accordingly, the data for each element or component is arranged in a list of numbers or values and is divided into quarters for obtaining the quartiles, i.e. 1st quartile, 2nd quartile and 3rd quartile. The 1st quartile is defined as the middle number between the smallest number and the median of the data. The 2nd quartile is the median of the data. The 3rd quartile is the middle value between the median and the highest value of the data. The quartiles obtained thereof are shown in Figure 3b. Figure 3b, being part of the step **200**, illustrates the normalization operation of the data on temperature readings for Group A and Group B of the elements or components. A normalized range from 0 to 1 is obtained and shown in this figure.

Figure 4a illustrates, in respect of the data on measurement reading, the step **300** of determining a fuzzy class and a confidence level for each of the elements or components in Group A based on the normalized range. Figure 4b, on the other hand, illustrates the same operation as Figure 4a but for the elements or components in Group B. The plots of Figures 4a and 4b comprises a Y-axis of confidence level and an X-axis of normalized range. From these plots, an intersection of the 1st quartile and the 3rd quartile of the X-axis with the 1 value of the Y-axis is determined (see dotted line in Figures 4a and 4b). The intersection is used as a “shoulder” for determining a graph area for the fuzzy classes (e.g. LO fuzzy class and HI fuzzy class). The shoulder is the point before which the confidence level that a particular value between the LO fuzzy class and the HI fuzzy class starts to drop.

Figures 5a and 5b are respectively similar to that explanation of Figures 3a and 3b except that Figures 5a and 5b are for the data on frequency of use or usage. The 1st quartile, the 2nd quartile and the 3rd quartile in respect of the data on frequency of use are calculated and determined for Group A and Group B of elements or components. In continuation from these figures, a fuzzy class, a

confidence level, an intersection and henceforth, a shoulder for determining a graph area for the fuzzy classes (e.g. LO fuzzy class, MED fuzzy class and HI fuzzy class) are determined, as shown in Figures 6a and 6b. Figures 6a and 6b are respectively similar to that explanation of Figures 4a and 4b except that Figures 6a and 6b are for the data on frequency of use or usage, and involve three fuzzy classes (i.e. LO fuzzy class, MED fuzzy class and HI fuzzy class).

Figure 7 illustrates the step **400** of correspondingly combining the fuzzy class of the data on frequency of use with the fuzzy class of the data on measurement reading for each of the elements or components so as to obtain a ranking list of the elements or components. In this regard, a combination metric defined for each fuzzy class combination of the fuzzy class of the data on frequency of use and the fuzzy class of the data on temperature readings is employed. The combination metric has a predefined priority value (e.g. 1, 2, 3, 4, 5 and 6) that can be assigned to each fuzzy class combination, e.g. fuzzy class combination 1: HI fuzzy class (based on the data on temperature reading) and HI fuzzy class (based on the data on frequency of use); fuzzy class combination 2: HI fuzzy class (based on the data on temperature reading) and MED fuzzy class (based on the data on frequency of use) and so forth. For example, consider Class 2 (C2) of element or component class, the fuzzy class based on the data on measurement reading is HI fuzzy class (see dashed line in Figure 7 of plot A) and the fuzzy class based on the data on frequency of use is MED fuzzy class (see dashed line in Figure 7 of plot B) are combined together thereby formed a fuzzy class combination 2 which carries a priority value of 2 – thus, C2 is ranked second place in the ranking list.

The terms “a” and “an,” as used herein, are defined as one or more than one. The term “plurality,” as used herein, is defined as two or more than two. The term “another,” as used herein, is defined as at least a second or more. The terms “including” and/or “having,” as used herein, are defined as comprising (i.e., open language).

While this invention has been particularly shown and described with reference to the exemplary embodiments thereof, it will be understood by those skilled in the art that various changes in form and details may be made therein

without departing from the scope of the invention as defined by the appended claims.

CLAIMS

1. A method of ranking elements or components in a computing environment with limited resources, **characterized in that**, the method comprising the steps of:

retrieving and analyzing historical data from a database associated with the elements or components (100), wherein the historical data includes data on frequency of use and data on measurement reading for each of the elements or components;

for each of the data on frequency of use and the data on measurement reading, generating fuzzy classes with a set of thresholds for the elements or components thereof (200), wherein the step of generating fuzzy classes comprises:

determining quartiles of the data on frequency of use and the data on measurement reading; and

subjecting the data on frequency of use and the data on measurement reading to normalization to obtain a normalized range from 0 to 1;

for each of the data on frequency of use and the data on measurement reading, determining, based on the normalized range, a fuzzy class assigned based on the fuzzy classes generated thereof and a confidence level for each of the elements or components by way of comparing the data on frequency of use and the data on measurement reading of the elements or components against the set of thresholds (300); and

for each of the elements or components, correspondingly combining the fuzzy class of the data on frequency of use with the fuzzy class of the data on measurement reading to obtain a ranking list of the elements or components (400)., wherein the ranking list ranks the elements or components according to a combination metric defined for each fuzzy class combination of the fuzzy class of the data on frequency of use and the fuzzy class of the data on measurement reading

2. The method according to Claim 1 further comprises the step of dividing the elements or components thereof into a plurality of groups.

3. The method according to Claim 1 further comprises the step of assigning a numerical range for the elements or components retrieved thereof.

4. The method according to Claim 1, wherein the step of determining quartiles includes determining a first quartile, a second quartile and a third quartile.

5. The method according to Claim 1, wherein the fuzzy classes comprise a low fuzzy class, a medium fuzzy class and a high fuzzy class.

6. The method according to Claim 1 further comprises the step of displaying the elements or components in rank order based on the ranking list thereof (500).

7. The method according to Claim 1 further comprises the step of developing a combination metric based on fuzzy class combinations of the elements or components.

8. A non-transitory computer readable medium comprising a plurality of computer executable instructions that, in response to a user request, executes a method of ranking elements or components in a computing environment with limited resources, the method comprising the steps of:

retrieving and analyzing historical data from a database associated with the elements or components (100), wherein the historical data includes data on frequency of use and data on measurement reading for each of the elements or components;

for each of the data on frequency of use and the data on measurement reading, generating fuzzy classes with a set of thresholds for the elements or components thereof (200), wherein the step of generating fuzzy classes comprises:

determining quartiles of the data on frequency of use and the data on measurement reading; and

subjecting the data on frequency of use and the data on measurement reading to normalization to obtain a normalized range from 0 to 1;

for each of the data on frequency of use and the data on measurement reading, determining, based on the normalized range, a fuzzy class assigned

based on the fuzzy classes generated thereof and a confidence level for each of the elements or components by way of comparing the data on frequency of use and the data on measurement reading of the elements or components against the set of thresholds (300); and

for each of the elements or components, correspondingly combining the fuzzy class of the data on frequency of use with the fuzzy class of the data on measurement reading to obtain a ranking list of the elements or components, wherein the ranking list ranks the elements or components according to a combination metric defined for each fuzzy class combination of the fuzzy class of the data on frequency of use and the fuzzy class of the data on measurement reading (400).

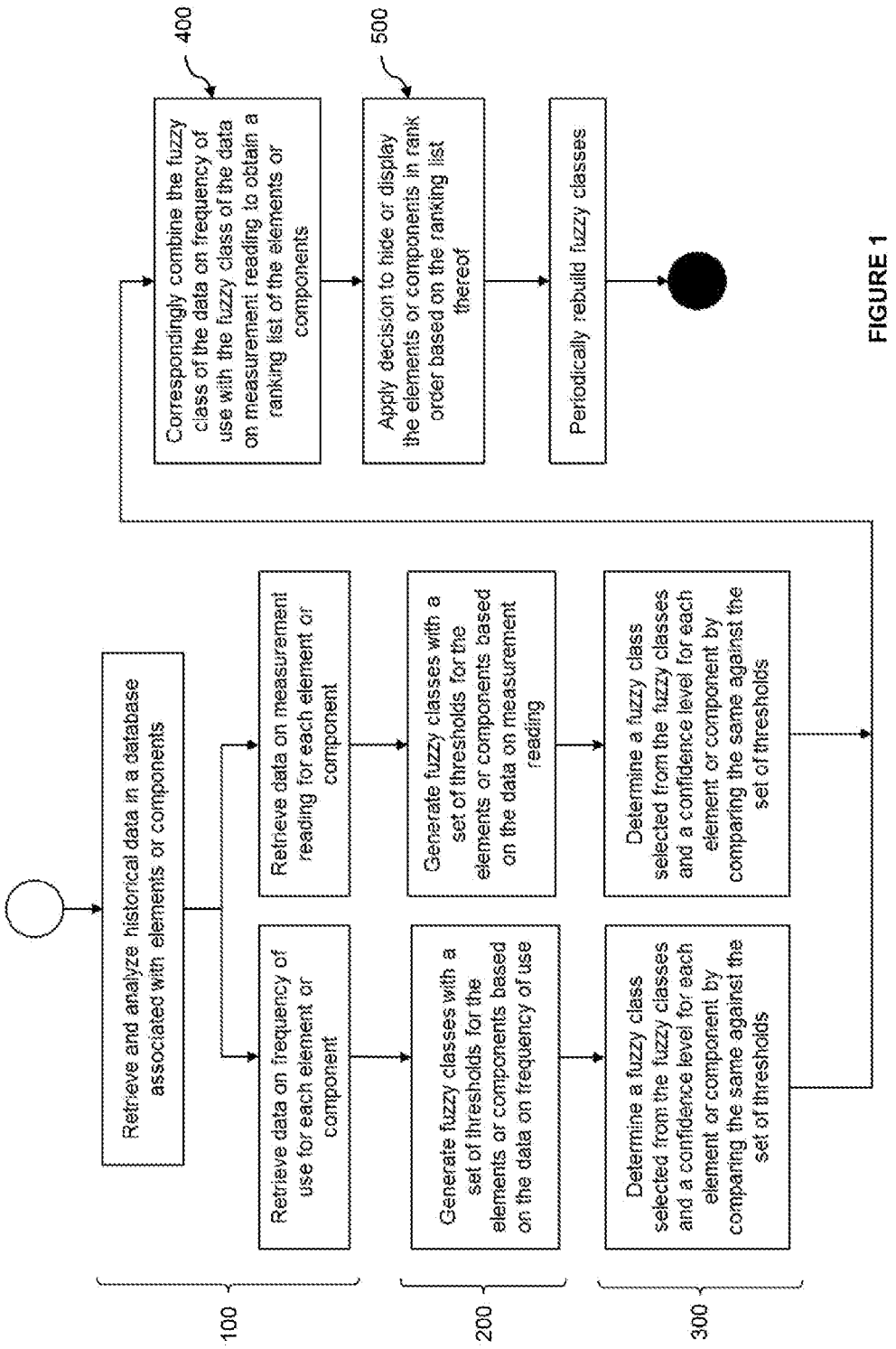
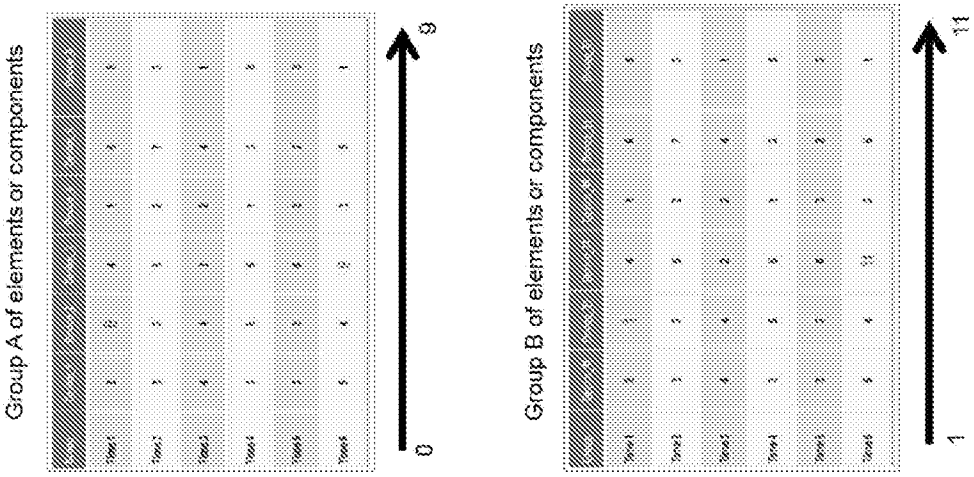

Retrieve and analyze historical data in a database associated with elements or components
Retrieve data on frequency of use for each element or component
Retrieve data on measurement reading for each element or component
Generate fuzzy classes with a set of thresholds for the elements or components based on the data on frequency of use
Generate fuzzy classes with a set of thresholds for the elements or components based on the data on measurement reading
Determine a fuzzy class selected from the fuzzy classes and a confidence level for each element or component by comparing the same against the set of thresholds
Determine a fuzzy class selected from the fuzzy classes and a confidence level for each element or component by comparing the same against the set of thresholds
100
200
300
400
Correspondingly combine the fuzzy class of the data on frequency of use with the fuzzy class of the data on measurement reading to obtain a ranking list of the elements or components
500
Apply decision to hide or display the elements or components in rank order based on the ranking list thereof
Periodically rebuild fuzzy classes

FIGURE 1



Group	Device _11	Device _21	Device _31	Device _41	Device _51	Device _61
Time 1	2	1	4	1	6	8
Time 2	3	3	5	2	7	3
Time 3	4	4	2	2	4	1
Time 4	3	5	5	1	3	8
Time 5	3	3	8	3	2	3
Time 6	5	4	11	3	5	1

E.g. The elements or components' group range is from 1 (min) to 11 (max)

FIGURE 2

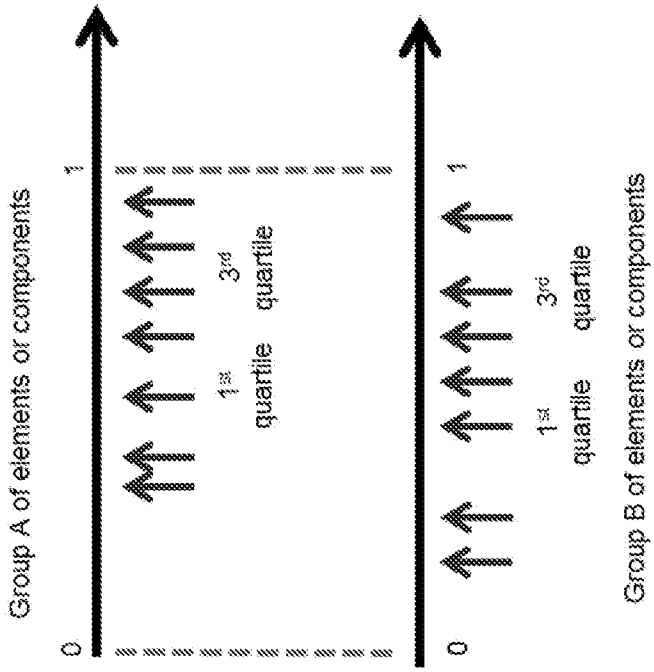


FIGURE 3b

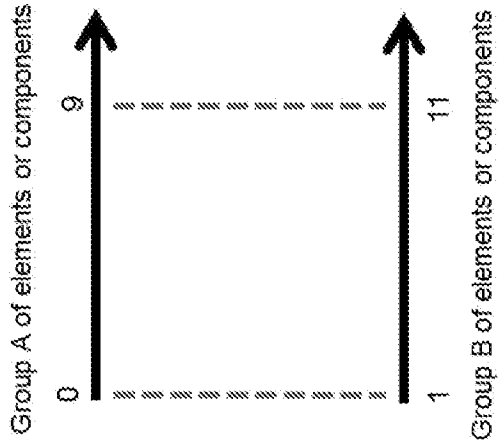


FIGURE 3a

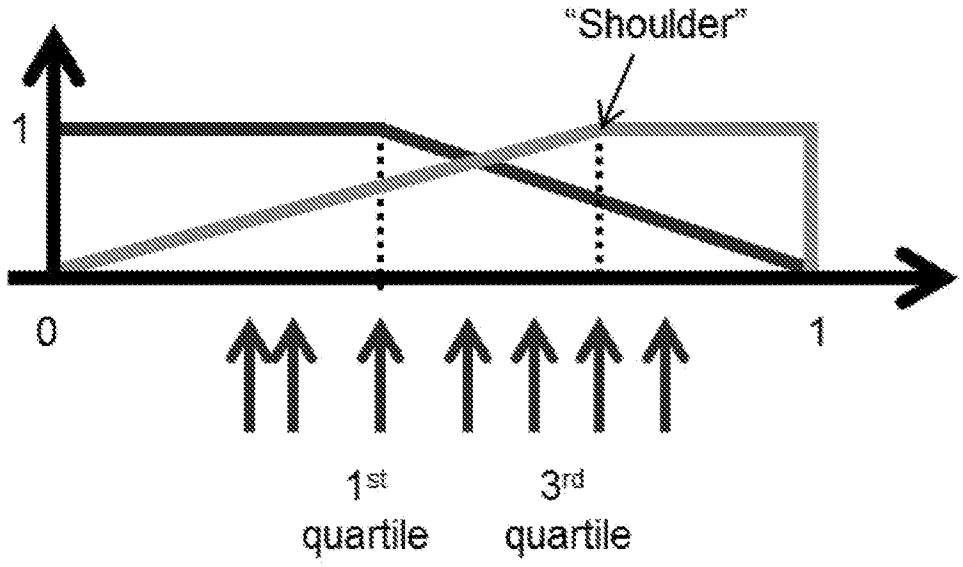


FIGURE 4a

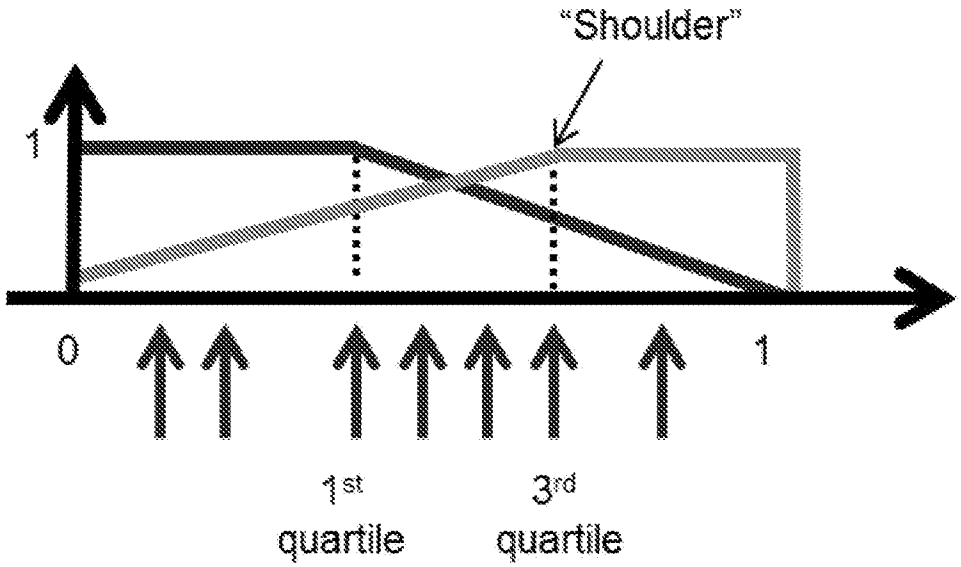


FIGURE 4b

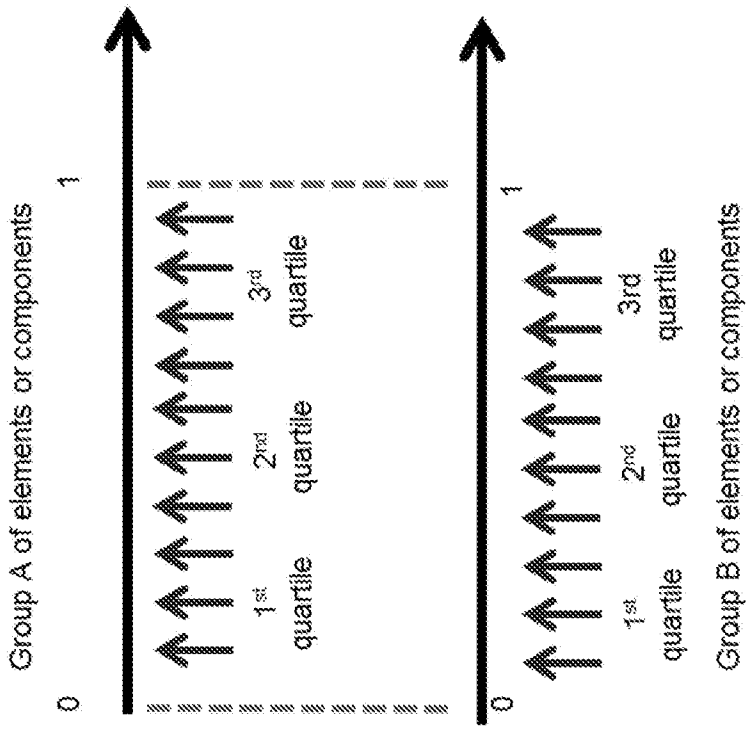


FIGURE 5b

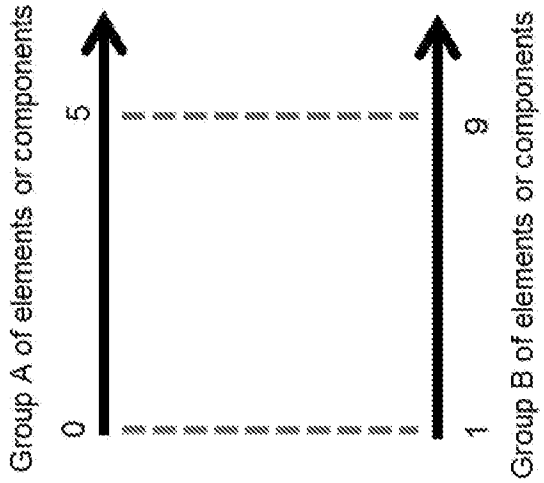


FIGURE 5a

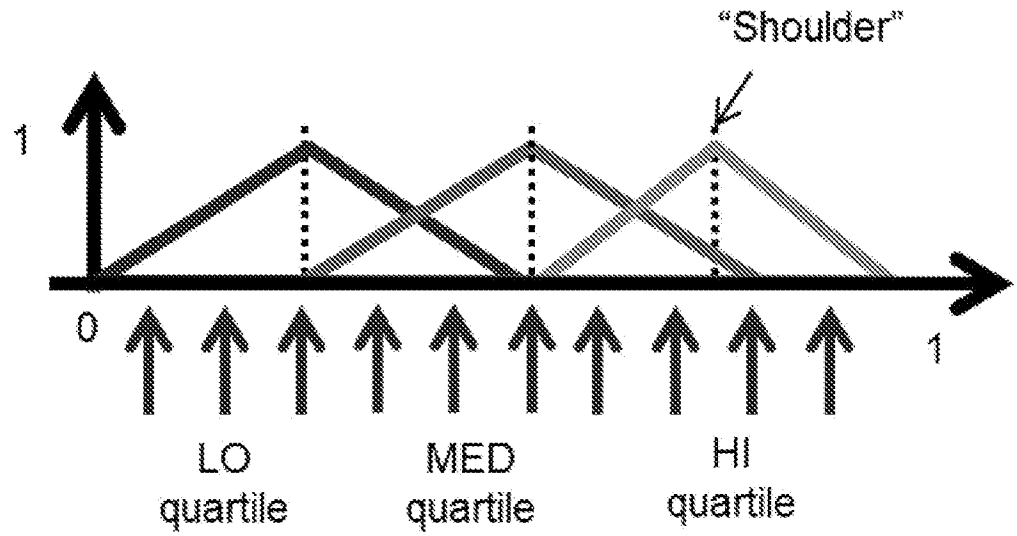


FIGURE 6a

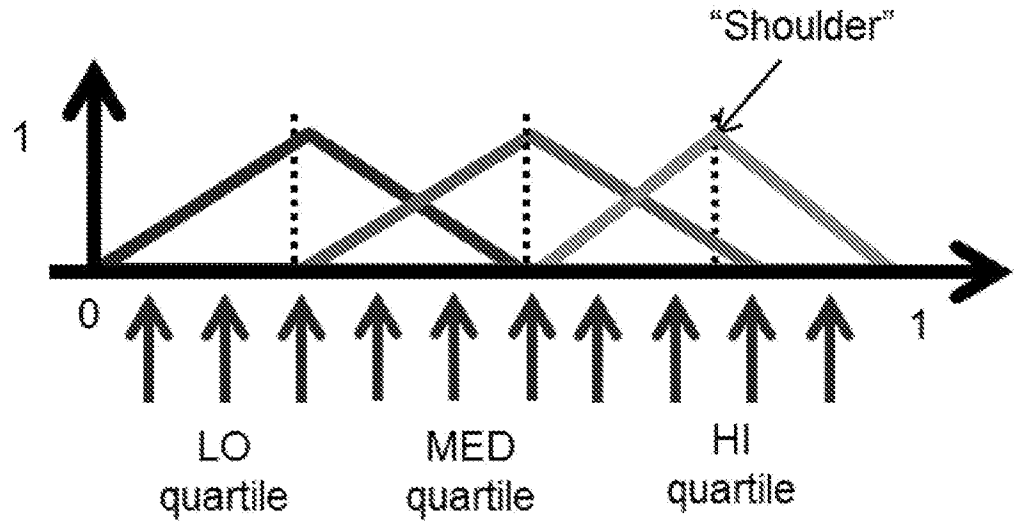


FIGURE 6b

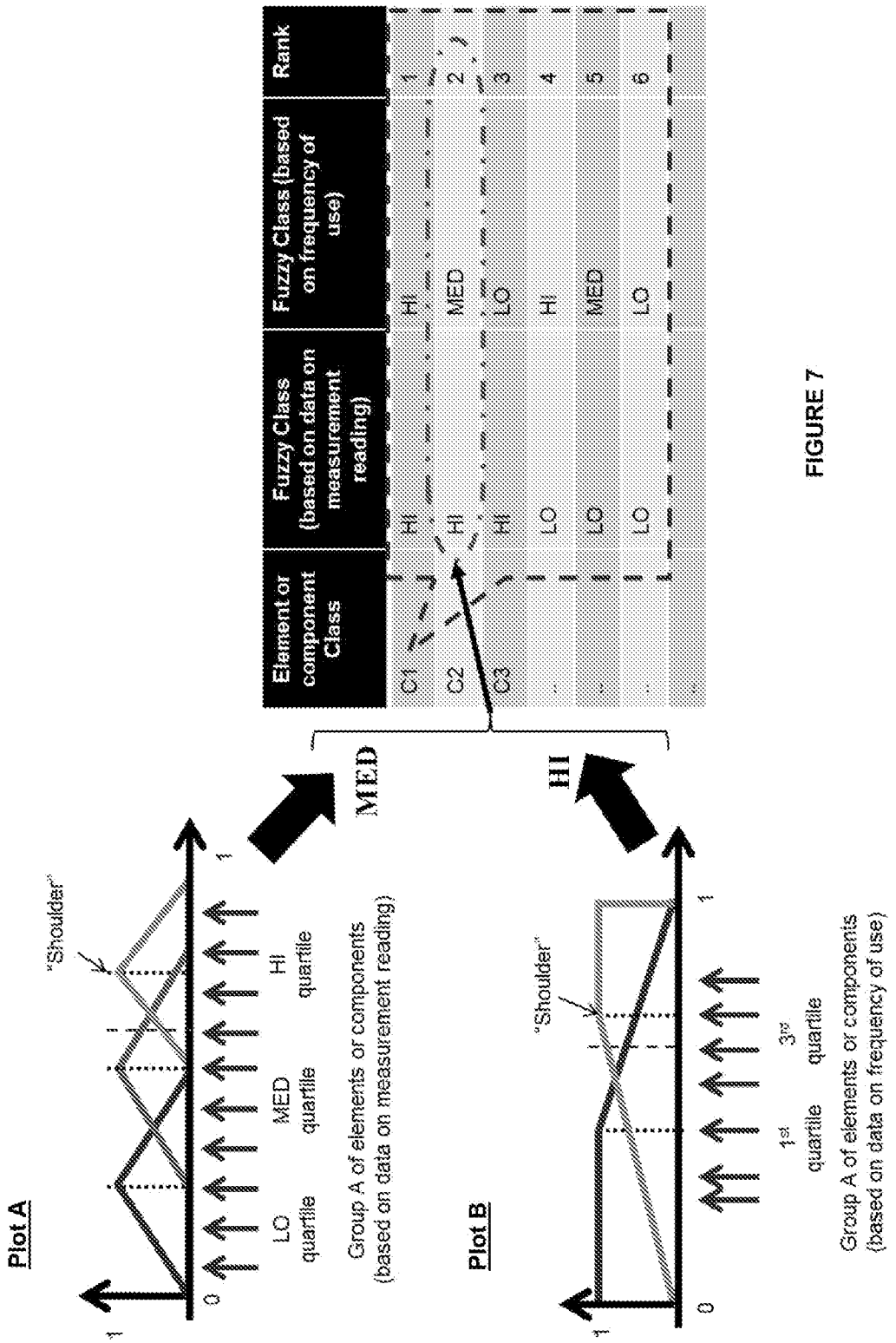

Plot A
"Shoulder"
LO quartile
MED quartile
Hi quartile
Group A of elements or components (based on data on measurement reading)
MED
Element or component Class
Fuzzy Class (based on data on measurement reading)
Fuzzy Class (based on frequency of use)
Rank
C1
C2
C3
Hi
LO
MED
1
2
3
4
5
6
HI
Plot B
"Shoulder"
1st quartile
3rd quartile
Group A of elements or components (based on data on frequency of use)

FIGURE 7

INTERNATIONAL SEARCH REPORT

International application No.
PCT/MY2019/050091

A. CLASSIFICATION OF SUBJECT MATTER

G06F 11/30(2006.01)i
FI: G06F11/30 168; G06F11/30 140A

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

G06F11/30

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

Published examined utility model applications of Japan 1922-1996
Published unexamined utility model applications of Japan 1971-2020
Registered utility model specifications of Japan 1996-2020
Published registered utility model applications of Japan 1994-2020

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WO 2018/131147 A1 (HITACHI, LTD.) 19 July 2018 (2018-07-19) whole document	1-8
A	JP 2014-85834 A (SUGAYA, Syunji) 12 May 2014 (2014-05-12) whole document	1-8

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

☑ See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier application or patent but published on or after the international filing date
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"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
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"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
19 February 2020	**03 March 2020**
Name and mailing address of the ISA/JP **Japan Patent Office** **3-4-3, Kasumigaseki, Chiyoda-ku, Tokyo** **100-8915, Japan**	Authorized officer **TSUKADA, Hajime 5B 3652** Telephone No. **+81-3-3581-1101 Ext. 3545**

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/MY2019/050091

Patent document cited in search report	Publication date (day/month/year)	Patent family member(s)	Publication date (day/month/year)
WO 2018/131147 A1	19 July 2018	US 2019/0108082 A1	
JP 2014-85834 A	12 May 2014	(Family: none)	