US 20210141841A1

(19) **United States**

(12) **Patent Application Publication**

SEIMASA

(10) **Pub. No.: US 2021/0141841 A1**

(43) **Pub. Date: May 13, 2021**

(54) **DOCUMENT PROCESSING DEVICE, METHOD OF CONTROLLING DOCUMENT PROCESSING DEVICE, AND NON-TRANSITORY COMPUTER-READABLE RECORDING MEDIUM CONTAINING CONTROL PROGRAM**

(71) Applicant: **FRONTEO, Inc.**, Tokyo (JP)

(72) Inventor: **Takafumi SEIMASA**, Tokyo (JP)

(73) Assignee: **FRONTEO, Inc.**, Tokyo (JP)

(21) Appl. No.: **17/094,907**

(22) Filed: **Nov. 11, 2020**

(30) **Foreign Application Priority Data**

Nov. 13, 2019 (JP) 2019-205267

Publication Classification

(51) **Int. Cl.**

G06F 16/93	(2006.01)
G06F 16/906	(2006.01)
G06F 16/901	(2006.01)
G06F 16/9035	(2006.01)

(52) **U.S. Cl.**

CPC ***G06F 16/93*** (2019.01); ***G06F 16/9035*** (2019.01); ***G06F 16/9014*** (2019.01); ***G06F 16/906*** (2019.01)

(57) **ABSTRACT**

A document processing device includes: a document classification section configured to sequentially apply a plurality of classification processes in a prescribed sequence to a plurality of documents to classify the plurality of documents into a plurality of groups; and a classification determination section configured to every time one of the plurality of classification processes is applied, determine whether or not each group contains two or more documents. The document classification section, after applying a preceding one of the plurality of classification processes, applies a succeeding one of the plurality of classification processes to the two or more documents in each group determined as containing the two or more documents. The prescribed sequence is an ascending order of an amount of calculation involved in the plurality of classification processes.

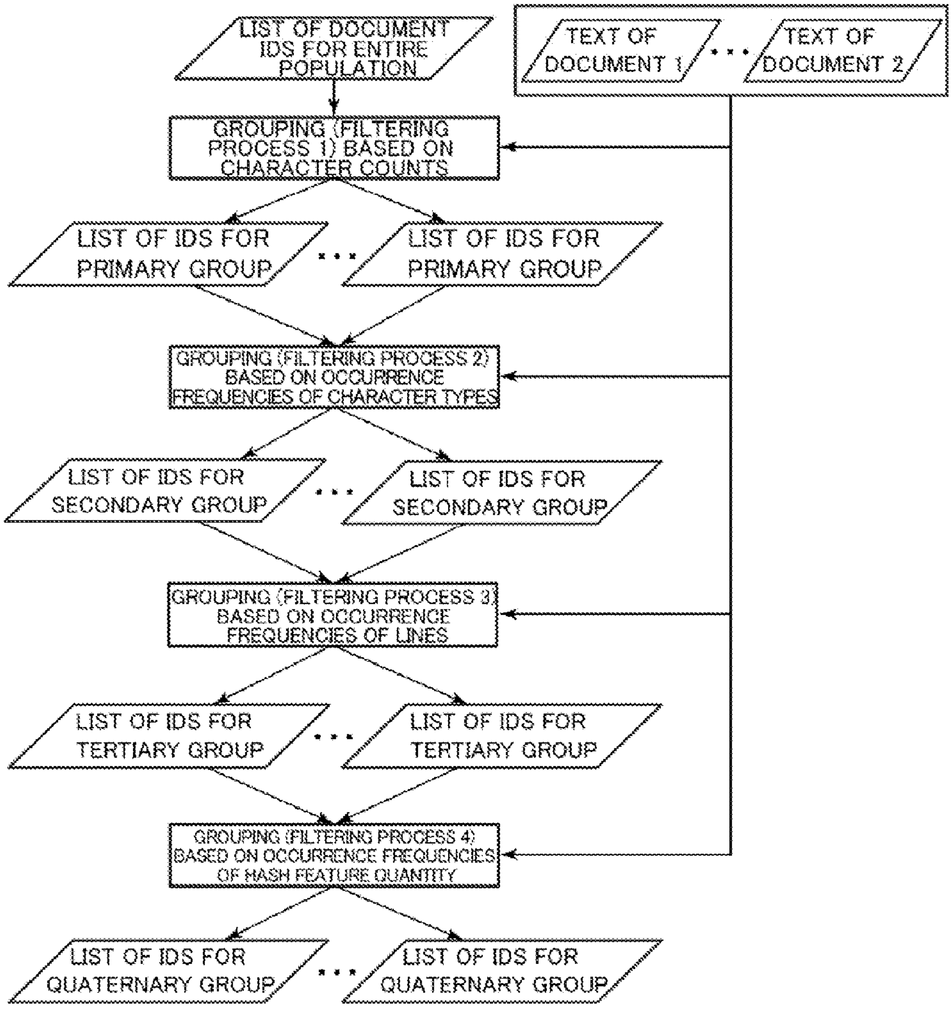

LIST OF DOCUMENT IDS FOR ENTIRE POPULATION
TEXT OF DOCUMENT 1
TEXT OF DOCUMENT 2
GROUPING (FILTERING PROCESS 1) BASED ON CHARACTER COUNTS
LIST OF IDS FOR PRIMARY GROUP
LIST OF IDS FOR PRIMARY GROUP
GROUPING (FILTERING PROCESS 2) BASED ON OCCURRENCE FREQUENCIES OF CHARACTER TYPES
LIST OF IDS FOR SECONDARY GROUP
LIST OF IDS FOR SECONDARY GROUP
GROUPING (FILTERING PROCESS 3) BASED ON OCCURRENCE FREQUENCIES OF LINES
LIST OF IDS FOR TERTIARY GROUP
LIST OF IDS FOR TERTIARY GROUP
GROUPING (FILTERING PROCESS 4) BASED ON OCCURRENCE FREQUENCIES OF HASH FEATURE QUANTITY
LIST OF IDS FOR QUATERNARY GROUP
LIST OF IDS FOR QUATERNARY GROUP

FIG.1

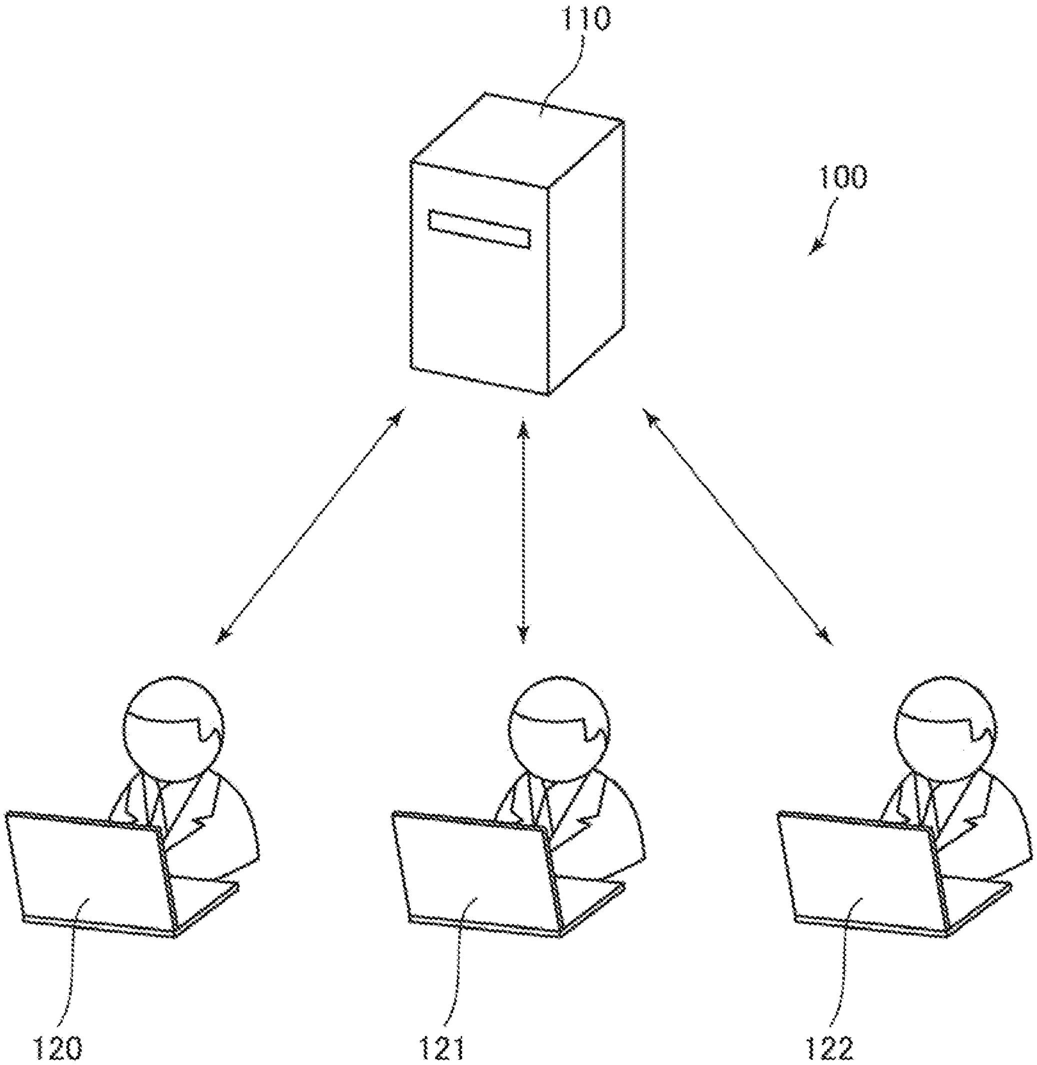


FIG.2

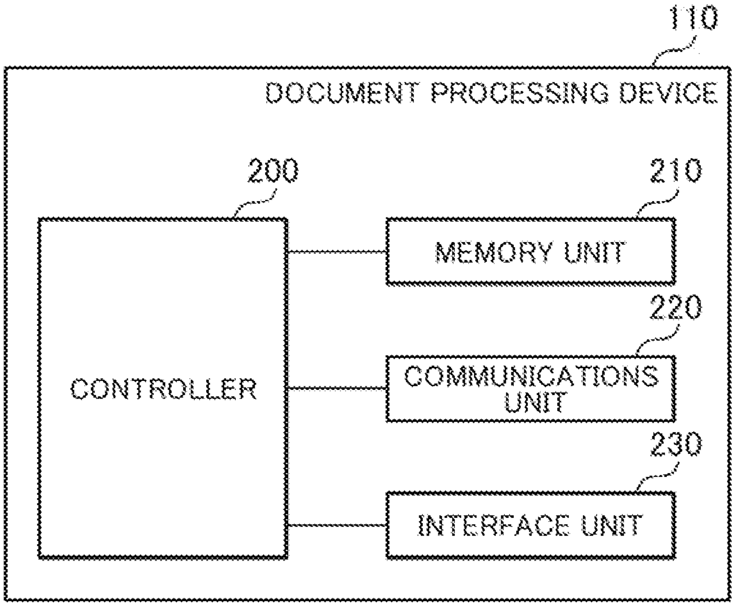

110
DOCUMENT PROCESSING DEVICE
200
CONTROLLER
210
MEMORY UNIT
220
COMMUNICATIONS UNIT
230
INTERFACE UNIT

FIG.3

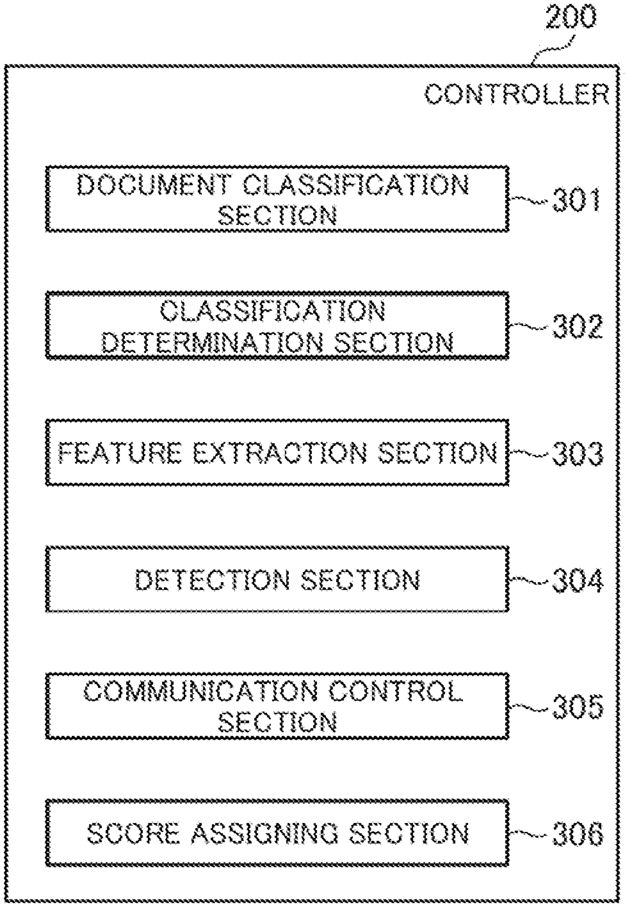

200
CONTROLLER
DOCUMENT CLASSIFICATION SECTION
301
CLASSIFICATION DETERMINATION SECTION
302
FEATURE EXTRACTION SECTION
303
DETECTION SECTION
304
COMMUNICATION CONTROL SECTION
305
SCORE ASSIGNING SECTION
306

FIG.4A

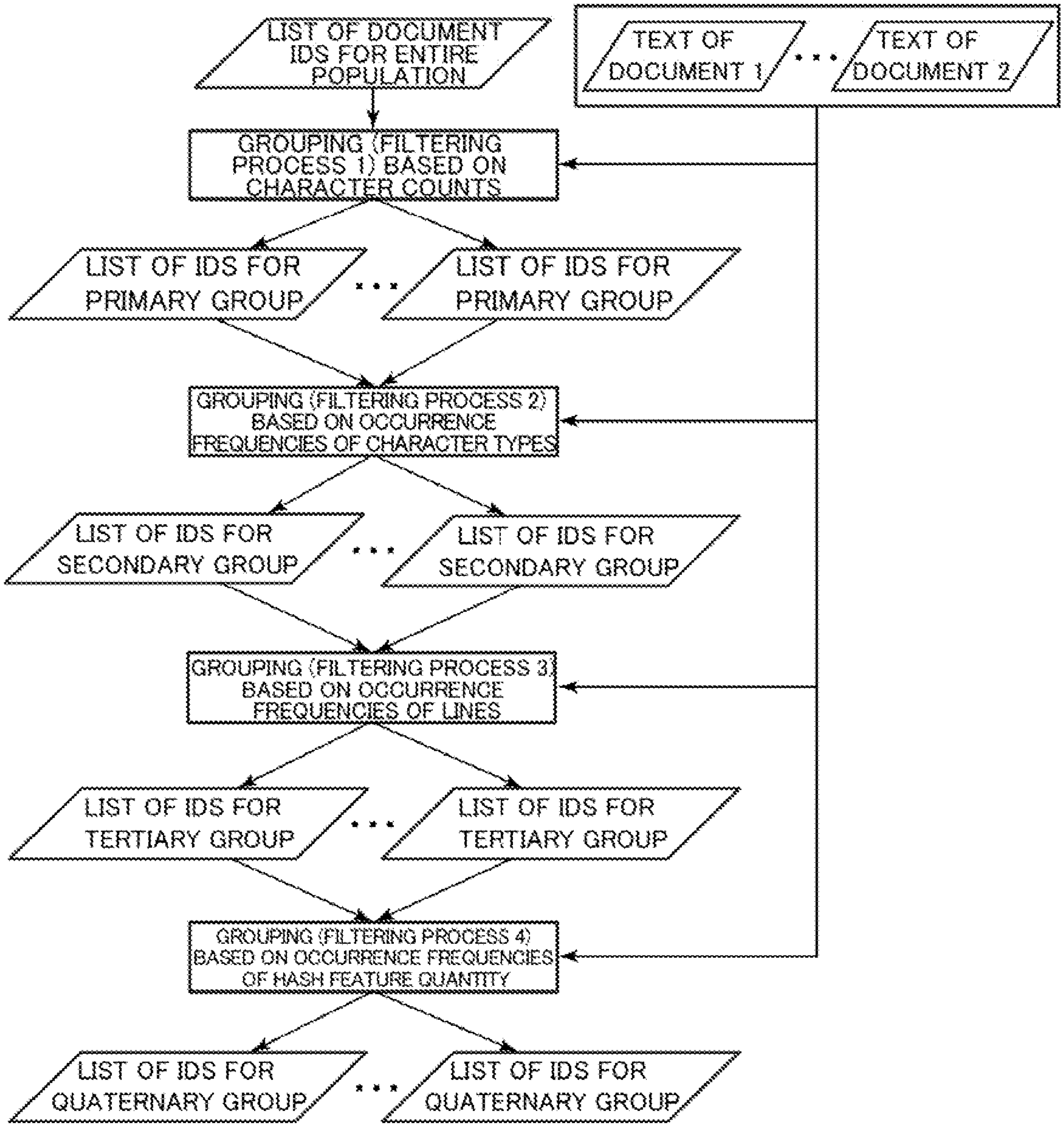

LIST OF DOCUMENT IDS FOR ENTIRE POPULATION
TEXT OF DOCUMENT 1
• • •
TEXT OF DOCUMENT 2
GROUPING (FILTERING PROCESS 1) BASED ON CHARACTER COUNTS
LIST OF IDS FOR PRIMARY GROUP
• • •
LIST OF IDS FOR PRIMARY GROUP
GROUPING (FILTERING PROCESS 2) BASED ON OCCURRENCE FREQUENCIES OF CHARACTER TYPES
LIST OF IDS FOR SECONDARY GROUP
• • •
LIST OF IDS FOR SECONDARY GROUP
GROUPING (FILTERING PROCESS 3) BASED ON OCCURRENCE FREQUENCIES OF LINES
LIST OF IDS FOR TERTIARY GROUP
• • •
LIST OF IDS FOR TERTIARY GROUP
GROUPING (FILTERING PROCESS 4) BASED ON OCCURRENCE FREQUENCIES OF HASH FEATURE QUANTITY
LIST OF IDS FOR QUATERNARY GROUP
• • •
LIST OF IDS FOR QUATERNARY GROUP

FIG.4B

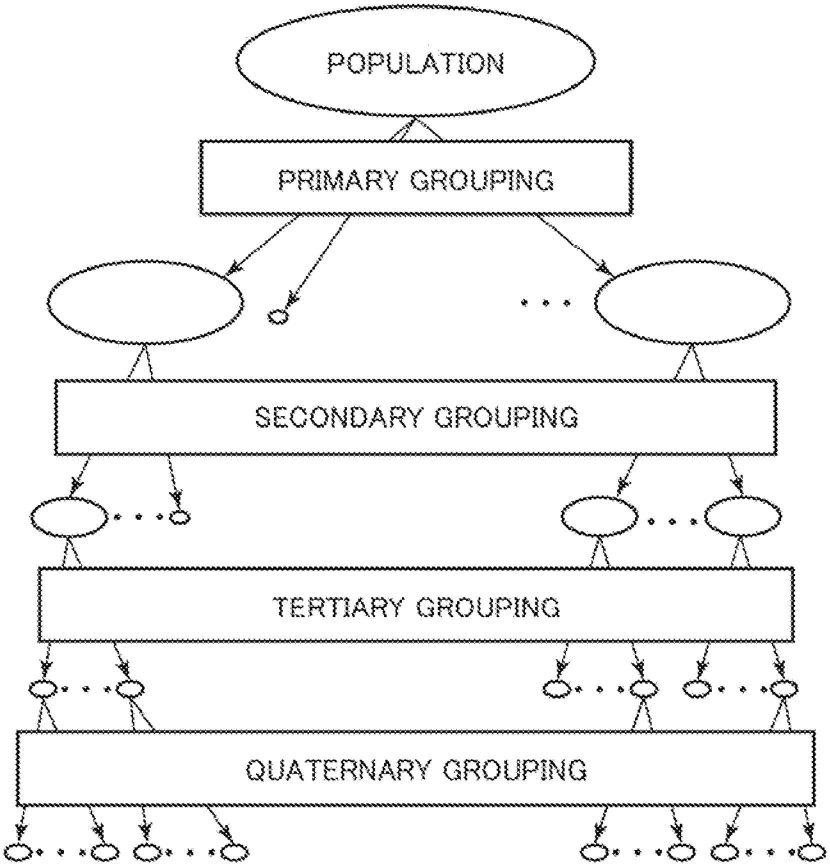

POPULATION
PRIMARY GROUPING
SECONDARY GROUPING
TERTIARY GROUPING
QUATERNARY GROUPING

FIG.5

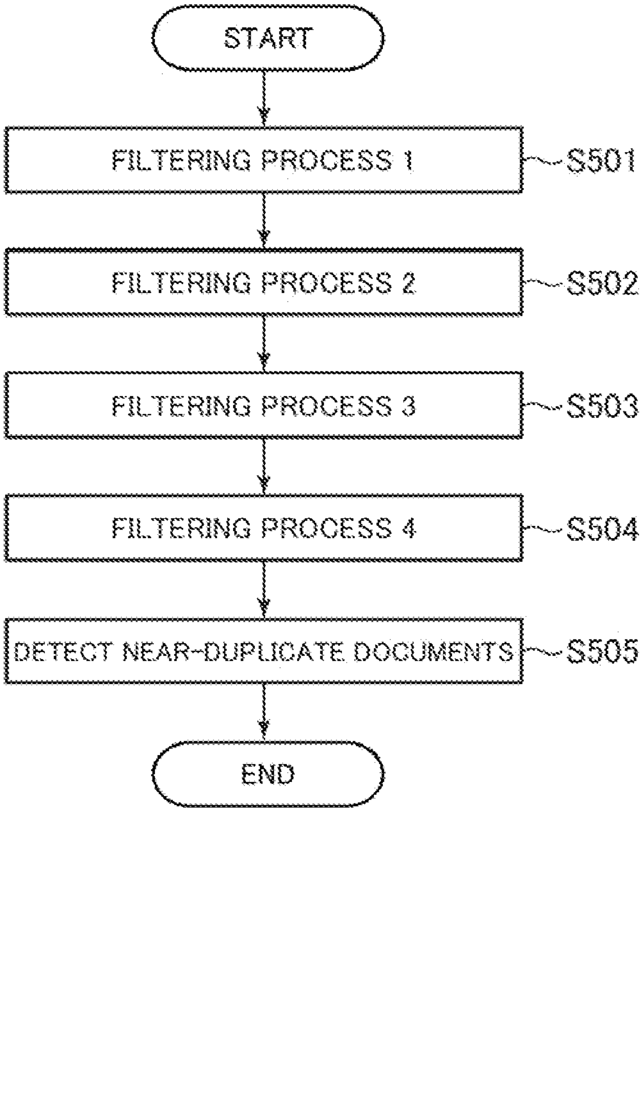

START
FILTERING PROCESS 1
S501
FILTERING PROCESS 2
S502
FILTERING PROCESS 3
S503
FILTERING PROCESS 4
S504
DETECT NEAR-DUPLICATE DOCUMENTS
S505
END

FIG.6

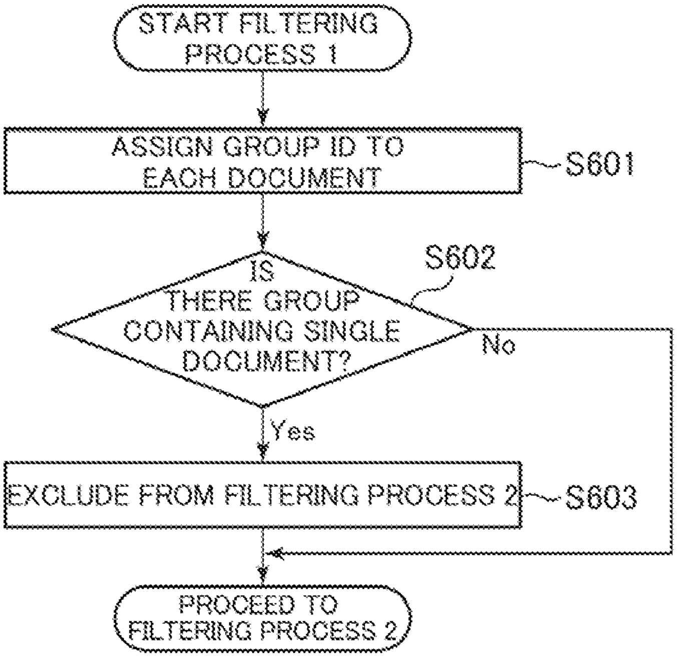

START FILTERING PROCESS 1
ASSIGN GROUP ID TO EACH DOCUMENT
S601
S602
IS THERE GROUP CONTAINING SINGLE DOCUMENT?
No
Yes
EXCLUDE FROM FILTERING PROCESS 2
S603
PROCEED TO FILTERING PROCESS 2

FIG.7

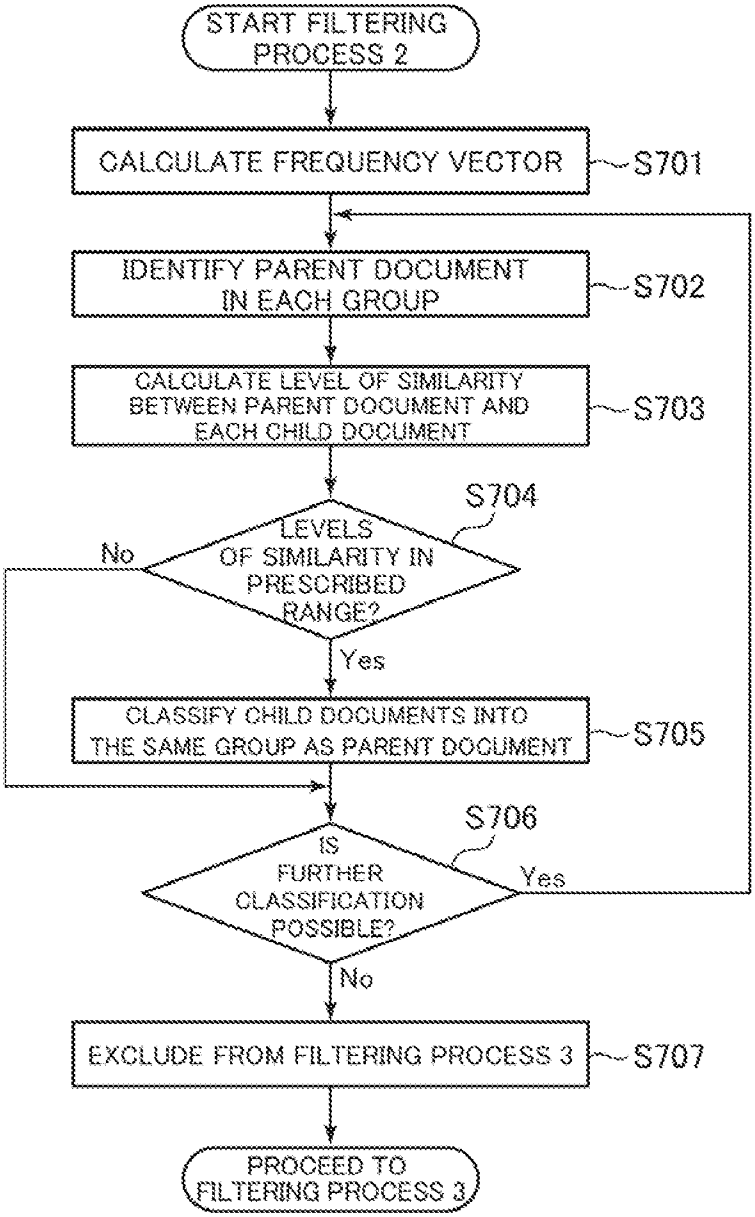

START FILTERING PROCESS 2
CALCULATE FREQUENCY VECTOR
S701
IDENTIFY PARENT DOCUMENT IN EACH GROUP
S702
CALCULATE LEVEL OF SIMILARITY BETWEEN PARENT DOCUMENT AND EACH CHILD DOCUMENT
S703
S704
LEVELS OF SIMILARITY IN PRESCRIBED RANGE?
No
Yes
CLASSIFY CHILD DOCUMENTS INTO THE SAME GROUP AS PARENT DOCUMENT
S705
S706
IS FURTHER CLASSIFICATION POSSIBLE?
Yes
No
EXCLUDE FROM FILTERING PROCESS 3
S707
PROCEED TO FILTERING PROCESS 3

FIG.8

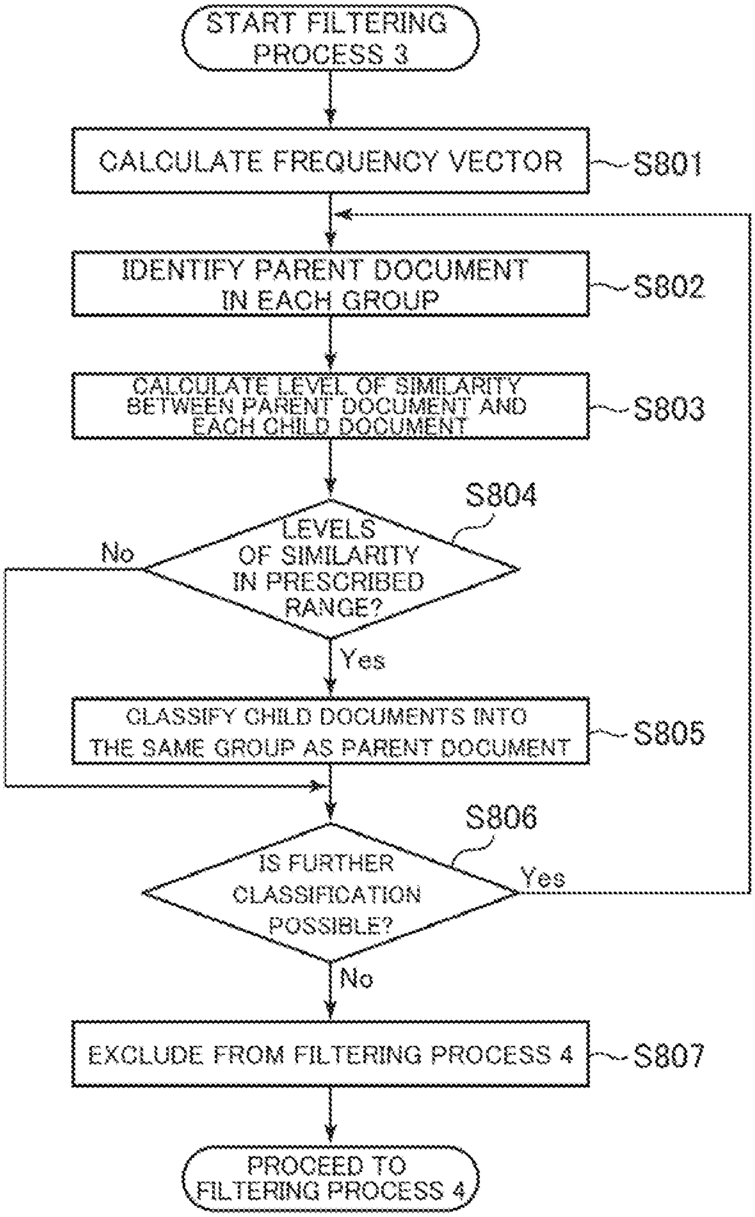
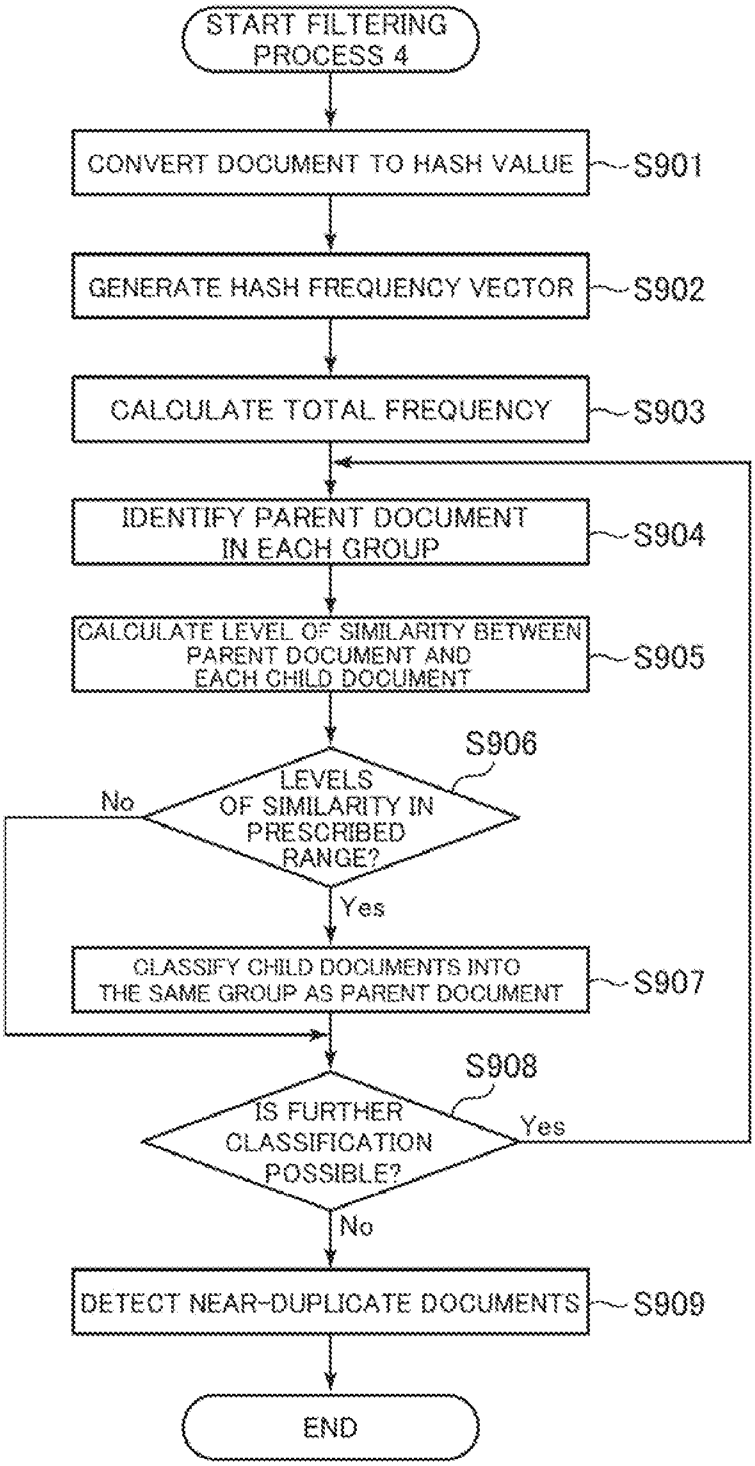

START FILTERING PROCESS 3
CALCULATE FREQUENCY VECTOR
S801
IDENTIFY PARENT DOCUMENT IN EACH GROUP
S802
CALCULATE LEVEL OF SIMILARITY BETWEEN PARENT DOCUMENT AND EACH CHILD DOCUMENT
S803
S804
LEVELS OF SIMILARITY IN PRESCRIBED RANGE?
No
Yes
CLASSIFY CHILD DOCUMENTS INTO THE SAME GROUP AS PARENT DOCUMENT
S805
S806
IS FURTHER CLASSIFICATION POSSIBLE?
Yes
No
EXCLUDE FROM FILTERING PROCESS 4
S807
PROCEED TO FILTERING PROCESS 4

FIG.9


START FILTERING PROCESS 4
CONVERT DOCUMENT TO HASH VALUE
S901
GENERATE HASH FREQUENCY VECTOR
S902
CALCULATE TOTAL FREQUENCY
S903
IDENTIFY PARENT DOCUMENT IN EACH GROUP
S904
CALCULATE LEVEL OF SIMILARITY BETWEEN PARENT DOCUMENT AND EACH CHILD DOCUMENT
S905
S906
LEVELS OF SIMILARITY IN PRESCRIBED RANGE?
No
Yes
CLASSIFY CHILD DOCUMENTS INTO THE SAME GROUP AS PARENT DOCUMENT
S907
S908
IS FURTHER CLASSIFICATION POSSIBLE?
Yes
No
DETECT NEAR-DUPLICATE DOCUMENTS
S909
END

DOCUMENT PROCESSING DEVICE, METHOD OF CONTROLLING DOCUMENT PROCESSING DEVICE, AND NON-TRANSITORY COMPUTER-READABLE RECORDING MEDIUM CONTAINING CONTROL PROGRAM

CROSS-REFERENCE TO RELATED APPLICATION

[0001] The present application claims priority from Japanese Patent Application No. 2019-205267 filed on Nov. 13, 2020, the entire contents of which are hereby incorporated by reference into this application.

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0002] The present disclosure relates primarily to document processing devices.

2. Description of the Related Art

[0003] Bassma S. Alsulami, and two others describe an approach to near duplicate document detection in their article, "Near Duplicate Document Detection Survey," International Journal of Computer Science & Communication Networks, Vol 2(2), 147-151.

SUMMARY OF THE INVENTION

[0004] The technology described in the article above may decelerate the detection of near-duplicate documents because the technology does not detect near-duplicate documents in accordance with the identicalness of two documents. In view of this problem, the present disclosure, in an aspect thereof, has an object to provide, for example, a document processing device that detects near-duplicate documents with improved speed without reducing detection accuracy.

[0005] According to the first aspect of the disclosure, a document processing device includes: a document classification section configured to sequentially apply a plurality of classification processes in a prescribed sequence to a plurality of documents to classify the plurality of documents into a plurality of groups; and a classification determination section configured to every time one of the plurality of classification processes is applied, determine whether or not each group contains two or more documents. The document classification section, after applying a preceding one of the plurality of classification processes, applies a succeeding one of the plurality of classification processes to the two or more documents in each group determined as containing the two or more documents. The prescribed sequence is an ascending order of an amount of calculation involved in the plurality of classification processes.

[0006] According to the second aspect of the disclosure, a method of controlling a document processing device includes: sequentially applying a plurality of classification processes in a prescribed sequence to a plurality of documents to classify the plurality of documents into a plurality of groups; and every time one of the plurality of classification processes is applied, determining whether or not each group contains two or more documents. In the classification of the plurality of documents into the plurality of groups, after applying a preceding one of the plurality of classification processes, the method applies a succeeding one of the plurality of classification processes to the two or more documents in each group determined as containing the two or more documents. The prescribed sequence is an ascending order of an amount of calculation involved in the plurality of classification processes.

[0007] According to the third aspect of the disclosure, a non-transitory computer-readable recording medium containing a control program that causes a computer to function as the document processing device described above, the control program, when executed by the computer, causes the computer to function as the document classification section and the classification determination section.

BRIEF DESCRIPTION OF THE DRAWINGS

[0008] FIG. **1** is a schematic illustration of an exemplary configuration of a document review system in accordance with an aspect of the present disclosure.

[0009] FIG. **2** is a diagram of an exemplary hardware configuration of a document processing device in accordance with an aspect of the present disclosure.

[0010] FIG. **3** is a functional block diagram of an exemplary functional configuration of a controller in the document processing device.

[0011] FIG. **4**A is a schematic diagram of an exemplary process of the document processing device detecting near-duplicate documents.

[0012] FIG. **4**B is a schematic diagram of the exemplary process of the document processing device detecting near-duplicate documents.

[0013] FIG. **5** is a flow chart representing an exemplary process of the document processing device detecting near-duplicate documents.

[0014] FIG. **6** is a flow chart representing an exemplary filtering process **1** implemented by the document processing device.

[0015] FIG. **7** is a flow chart representing an exemplary filtering process **2** implemented by the document processing device.

[0016] FIG. **8** is a flow chart representing an exemplary filtering process **3** implemented by the document processing device.

[0017] FIG. **9** is a flow chart representing an exemplary filtering process **4** implemented by the document processing device.

DETAILED DESCRIPTION OF THE INVENTION

[0018] The following will describe an aspect of the present disclosure with reference to FIGS. **1** to **9**. Identical or equivalent elements in the drawings are denoted by the same reference numerals, and description thereof is not repeated.

[0019] Configuration of Document Review System **100**

[0020] FIG. **1** is a schematic illustration of an exemplary configuration of a document review system **100**. The document review system **100** is a system that enables reviewers to efficiently review documents (examine document content). As shown as an example in FIG. **1**, the document review system **100** includes a document processing device **110** and user terminals **120** to **122**.

[0021] The document processing device **110** enables systematic operation of the document review system **100** and, for example, has a function of evaluating how closely a document is related to an event. Each document may be electronic data in any format that at least partially contains, for example, characters, numbers, and/or symbols and may be, for example, document data (e.g., email, meeting minutes, specifications, user manuals, various technical documents, various reports, contracts, marketing material, business plans, electronic clinical records, or Web pages), presentation data, spreadsheet data, or an image or video at least partially representing text. An event may be anything that a reviewer finds relevant or irrelevant to a document and may be, for example, a lawsuit, an information leak, a compliance violation, a harassment, another illegal activity, a resignation, an accident, or an illness.

[0022] The user terminals **120** to **122** are for use by respective reviewers in reviewing documents and are connected to the document processing device **110** to be communicable each other. FIG. **1** shows an example where there are provided three user terminals. Alternatively, there may be provided one or more user terminals. Each reviewer reviews the document displayed on the user terminal **120** to **122** in terms of the relevance thereof to the event in accordance with prescribed criteria specified for the event and enters results of the review on the user terminal **120** to **122**.

[0023] A description is now given of document review procedures by a reviewer using the document review system **100**, by taking a lawsuit in the United States as an example of the event. A party in a lawsuit in the United States may have to undergo a discovery process. In other words, a party in a lawsuit may have to submit documents related to the lawsuit to the court and disclose the documents for hearings. In the process, numerous documents that may or may not be relevant to the lawsuit need to be classified into a group of those relevant to the lawsuit and a group of those irrelevant to the lawsuit in order to submit only those documents that are relevant to the lawsuit.

[0024] Reviewers are accordingly required to review documents that may be relevant to the lawsuit (hereinafter, will be referred to as "population") and determine for each document, for example, that the document is, for example, relevant to the lawsuit or irrelevant to the lawsuit. The population, which may contain from a few tens of thousands to a few millions of documents, is so large that the series of tasks related to the document review procedures needs to be streamlined.

[0025] A description is now given of an exemplary approach to the streamlining of the tasks as it is performed by the document review system **100**. For example, the document processing device **110** first randomly extracts a small number of documents (e.g., 100 to 200 documents) from the population and transmits these documents to the user terminals **120** to **122**. The user terminals **120** to **122** then present the documents to reviewers.

[0026] Each reviewer reviews this small number of documents presented to him/her (hereinafter, will be referred to as "pre-reviewing") and enters results of determining whether or not each document is relevant to the lawsuit on the user terminal **120** to **122**. For instance, if the reviewer determines, in the pre-reviewing of the document, that the document is relevant to the lawsuit, he/she gives a "Relevant" label to the document to indicate that the document is relevant to the lawsuit. On the other hand, if the reviewer determines that the document is irrelevant, he/she gives a "Not-relevant" label to the document to indicate that the document is irrelevant to the lawsuit.

[0027] The reviewer gives a "Relevant" label or a "Not-relevant" label to each of the small number of documents. The user terminal **120** to **122** then transmits the labeling as a result of the pre-reviewing to the document processing device **110**. Thereafter, the document processing device **110** causes an identifying model to learn using the result of the pre-reviewing. The identifying model identifies documents with the "Relevant" label on the basis of the result of the pre-reviewing. The identifying model may be any model of any type so long as the model is capable of identifying documents.

[0028] Next, the document processing device **110** assigns a score to each document in the population by using the identifying model. The score may be any indicator of the relevance of the document to the lawsuit and may be, for example, a numerical value in the range of 1 to 10,000 or a designation such as "high," "intermediate," or "low." The document processing device **110** assigns a higher score to a document with higher relevance and assigns a lower score to a document with lower relevance. In other words, the document processing device **110** evaluates the relevance of the document to the lawsuit through the score calculated using the learned identifying model.

[0029] Hence, the document processing device **110** can, for example, have the reviewers sequentially review the documents in the descending order of the scores thereof and exclude documents having a lower score than a prescribed value from reviewing. In other words, the document review system **100** enables the reviewers to review documents lightly or heavily in accordance with the scores assigned by the document processing device **110**. The document review system **100** can hence improve efficiency in reviewers reviewing numerous documents.

[0030] The present embodiment has been described assuming that the event is a lawsuit in the United States. The document review system **100** is also capable of improving reviewing efficiency through similar procedures when the event is something other than a lawsuit.

Hardware Configuration of Document Processing Device **110**

[0031] FIG. **2** is a diagram of an exemplary hardware configuration of the document processing device **110**. As shown as an example in FIG. **2**, the document processing device **110** includes, for example, a controller **200**, a memory unit **210**, a communications unit **220**, and an interface unit **230**.

[0032] The controller **200** has a function of collectively controlling various functions of the document processing device **110** and is realized using, for example, a CPU (central processing unit) or a like processor. The controller **200** causes each section in the controller **200**, which will be described later with reference to FIG. **3**, to function in accordance with control programs contained in the memory unit **210**.

[0033] The memory unit **210** is a storage device capable of storing information and may include, for example, a hard disk, an SSD (solid state drive), a semiconductor memory, or a DVD. The memory unit **210** contains, for example, control programs for the controller **200**, data required by the controller **200** to function properly, documents to be reviewed by reviewers, and identifying models used to identify documents. FIG. **2** shows the document processing device **110** including the memory unit **210**. Alternatively, for example, the document processing device **110** may include no memory unit **210** and instead use an external storage device (e.g., cloud storage) located outside the document processing device **110**.

[0034] The communications unit **220** transmits and receives documents and other data to and from the user terminals **120** to **122**. The communications unit **220** is, for example, a piece of hardware that is communicable with external devices over a network under a prescribed communication scheme. The communications unit **220** needs only to have functions through which communications with external devices can be achieved and is not limited, for example, in terms of communication lines, communication schemes, and communication media.

[0035] The interface unit **230** provides a connection interface to which input/output devices can be connected. The interface unit **230** may be, for example, a USB terminal, an HDMI® terminal, or an audio output terminal. The user of the document processing device **110** may connect, for example, a keyboard and a mouse to the USB terminal, so that he/she can input information to the document processing device **110**. Alternatively or additionally, the user may connect, for example, a display device to the HDMI® terminal to have a video information output of the document processing device **110** displayed on the display device.

Functional Configuration of Controller **200**

[0036] FIG. **3** is a functional block diagram of an exemplary functional configuration of the controller **200** in the document processing device **110**. As shown as an example in FIG. **3**, the controller **200** includes, for example, a document classification section **301**, a classification determination section **302**, a feature extraction section **303**, a detection section **304**, a communication control section **305**, and a score assigning section **306**.

[0037] The document classification section **301** sequentially applies filtering processes (classification processes) **1** to **4** in a prescribed sequence to a plurality of documents to classify the population (collection of documents) into groups. The prescribed sequence in this context is the ascending order of the amount of calculation involved in the filtering processes **1** to **4**. Each filtering process **1** to **4** in this context may be a process of further classifying a group evaluated as containing two or more documents. Specific examples of each filtering process will be described later with reference to FIGS. **5** to **9**.

[0038] After one of the filtering processes **1** to **4** (a "preceding classification process": e.g., the filtering process **1**) is applied, the document classification section **301** applies another one of the filtering processes **1** to **4** (a "succeeding classification process": e.g., the filtering process **2** which follows the filtering process **1**) to each document in a group(s) that the classification determination section **302** has evaluated as containing two or more documents.

[0039] Every time one of the filtering processes **1** to **4** is applied, the classification determination section **302** checks each resultant group to evaluate whether or not the group contains two or more documents. Differently put, every time one of the filtering processes **1** to **4** is applied, the classification determination section **302** checks each resultant group to determine whether or not there is a group containing a single document. If there is such a group, the document processing device **110** determines that there is no possibility that there is a near duplicate of the single document in the group and excludes the document from the succeeding filtering process. A detailed description will be given later with reference to FIGS. **5** to **9** on how these processes are made by the classification determination section **302**.

[0040] In each of the filtering processes **1** to **4**, the feature extraction section **303** may extract a common feature of the documents to be classified that matches that filtering process **1** to **4**. Specific examples of the feature extracted from the documents will be described later with reference to FIGS. **5** to **9**.

[0041] After the filtering process **4** (last classification process) is applied to the two or more documents, the detection section **304** may detect a plurality of documents (e.g., documents A to D, documents E to G, or documents H to I) in a group as being a set of duplicate or similar (near duplicate) documents. A detailed description will be given later with reference to FIGS. **5** to **9** on the process of detecting near-duplicate documents.

[0042] The communication control section **305** transmits documents to be reviewed by the reviewers to the respective user terminals **120** to **122** so that the user terminals **120** to **122** can present the documents to the reviewers. The communication control section **305** also receives results of the reviews carried out by the reviewers from the user terminals **120** to **122** to store the results in the memory unit **210**.

[0043] The score assigning section **306** assigns, to each document in the population, a score indicating the relevance of the document to an event (e.g., lawsuit) by using a prescribed identifying model. Specifically, the score assigning section **306** assigns a higher score to a document in the population with higher relevance to the event and assigns a lower score to a document with lower relevance by using an identifying model.

Detecting Near-Duplicate Documents

[0044] FIGS. **4**A and **4**B are schematic diagrams of an exemplary process of the document processing device **110** detecting near-duplicate documents. Two "near-duplicate" documents, for example, at least partially contain identical or similar text or content.

[0045] As an example, assume that document A contains N characters and also that document B contains M characters (N and M are natural numbers). The document processing device **110** may regard documents A and B as near-duplicate documents if $|N-M| \leq n$ where n is the number of identical characters in the documents. This number, "n," may be any natural number and, for example, set to different values in accordance with the types of the documents.

[0046] As an alternative example, assume that both documents A and B contain 10 pages. The document processing device **110** may regard documents A and B as near-duplicate documents, for example, if (a) the documents contain 9 pages of identical content in the same sequence or if (b) the documents contain 10 pages of identical content in the same sequence, but one different character in each page.

[0047] The document processing device **110** detects near-duplicate documents for the following purposes. If a reviewer determines that a document is relevant to an event, a document which is similar to the determined document with a relevancy is also likely to be relevant to the event. For instance, if a reviewer determines that an email is relevant to a lawsuit, an email that quotes the content of the first email is likely to be relevant to the lawsuit because the second email contains the content of the first email. Likewise, a third email that quotes the content of the second email is also relevant to the lawsuit.

[0048] When these three emails are detected to be near duplicates, the reviewer needs to review only one of the three emails, and it is safely presumed that reviewing of the remaining two emails will produce the same results. Accordingly, the document processing device **110** can increase reviewing efficiency by a factor of 3. As could be understood from this example, there are significant practical benefits in the document processing device **110** detecting near-duplicate documents.

[0049] As shown as an example in FIGS. **4**A and **4**B, the document processing device **110** sequentially carries out the filtering process **1** (primary grouping), the filtering process **2** (secondary grouping), the filtering process **3** (tertiary grouping), and the filtering process **4** (quaternary grouping) on each document to repeatedly divide (and subdivide) the population into groups. If there is a plurality of documents in a group after the filtering process **4**, the document processing device **110** detects these documents as near-duplicate documents.

[0050] On the other hand, if there is a single document in a group, it indicates that there is no near duplicate of that document. The document processing device **110** therefore stops carrying out filtering processes when there remains only one document in a group in a series of filtering processes.

[0051] FIG. **5** is a flow chart representing an exemplary process of the document processing device **110** detecting near-duplicate documents. As shown as an example in FIG. **5**, the document processing device **110** sequentially carries out the filtering processes **1** to **4** on the documents in the population (S**501** to S**504**) to finally detect near-duplicate documents (S**505**).

[0052] The document processing device **110** first applies the filtering process **1** to all the documents in the population (S**501**). Specifically, the document classification section **301** classifies the documents in the population into N**1** groups (N**1** is a natural number) on the basis of a feature extracted by the feature extraction section **303** (S**501**). Then, if there is a group containing a single document, the classification determination section **302** excludes the document from the filtering process **2**.

[0053] Next, the document processing device **110** applies the filtering process **2** to the remaining, non-excluded documents (S**502**). Specifically, the document classification section **301** classifies the documents to which the filtering process **2** is applied into N2 groups (N2 is a natural number) on the basis of another feature extracted by the feature extraction section **303** (S**502**). Then, if there is a group containing a single document, the classification determination section **302** excludes the document from the filtering process **3**.

[0054] Next, the document processing device **110** applies the filtering process **3** to the remaining, non-excluded documents (S**503**). Specifically, the document classification section **301** classifies the documents to which the filtering process **3** is applied into N3 groups (N3 is a natural number) on the basis of a further feature extracted by the feature extraction section **303** (S**503**). Then, if there is a group containing a single document, the classification determination section **302** excludes the document from the filtering process **4**.

[0055] Finally, the document processing device **110** applies the filtering process **4** to the remaining, non-excluded documents (S**504**). Specifically, the document classification section **301** classifies the documents to which the filtering process **4** is applied into N**4** groups (N**4** is a natural number) on the basis of yet another feature extracted by the feature extraction section **303** (S**504**). Then, the detection section **304** detects two or more documents that remain in a resultant group after the application of the filtering process **4** as near-duplicate documents (S**505**).

[0056] As described here, the document processing device **110** sequentially applies the filtering processes **1** to **4** to all the documents and excludes the documents for which no near duplicates are found from the succeeding filtering process. Then, if there still remains a plurality of documents in a group after the application of the filtering process **4**, the document processing device **110** determines that this plurality of documents is a set of near-duplicate documents.

[0057] Each filtering process will be described next in detail with reference to FIGS. **6** to **9**.

Filtering Process **1**

[0058] FIG. **6** is a flow chart representing an example of the filtering process **1** implemented by the document processing device **110**. Steps S**601** to S**603** shown in FIG. **6** constitute at least part of step S**501** shown as an example in FIG. **5**.

[0059] The feature extraction section **303** first calculates a quotient by dividing the character count of a document by a prescribed character count (e.g., 500 characters) and rounds down the quotient to the nearest whole number to extract the whole number as a feature of the document. Next, the document classification section **301** assigns a group ID to the document on the basis of the feature. For instance, if a document contains 1001 characters, the feature extraction section **303** calculates 1001/500=2.002, and the document classification section **301** assigns a group ID, “2,” to the document.

[0060] The feature extraction section **303** performs similar calculation on each document in the population, so that the document classification section **301** can assign a group ID to all the documents (S**601**). Next, the classification determination section **302** evaluates whether or not there is a group containing a single document (S**602**). If there is such a group (YES in step S**602**), the document processing device **110** determines that there is no possibility that there is a near duplicate of the single document in the group and excludes the document from the filtering process **2** (S**603**).

[0061] In other words, the filtering process **1** may be a classification process of counting characters in each document to classify the documents on the basis of the distribution of the character counts. Hence, the document processing device **110** is capable of classifying the documents on the basis of a tendency that documents with close character counts have similar content.

[0062] The feature extraction section **303** may increase or decrease the prescribed character count in a predetermined range. In so doing, the document classification section **301** assigns two or more group IDs to each document. For instance, if the feature extraction section **303** increases or decreases the prescribed character count in the range of 496 to 505, the document classification section **301** assigns **1** (when the prescribed character count is from 502 to 505) and **2** (when the prescribed character count is from **496** to **500**) as group IDs to a document containing 1001 characters. This configuration allows the document processing device **110** to assign group IDs in a flexible manner, thereby increasing accuracy in the classification.

Filtering Process **2**

[0063] FIG. **7** is a flow chart representing an example of the filtering process **2** implemented by the document processing device **110**. Steps S**701** to S**707** shown in FIG. **7** constitute at least part of step S**502** shown as an example in FIG. **5**.

[0064] The feature extraction section **303** first calculates a frequency vector for a document to which the filtering process **2** is to be applied to extract the frequency vector as a feature of the document (S**701**). A frequency vector is, for example, a vector containing a character count of each type of characters that appears in the document in an associated dimension.

[0065] As an example, assume that a document contains 250 Hiragana characters, 140 Katakana characters, 200 ideographs or Kanji characters, 340 alphabetic letters, 30 numeric characters, and 10 symbols. The document has a frequency vector of (**250**, **140**, **200**, **340**, **30**, **10**). The number of dimensions of the frequency vector may change with the definition of character types. For instance, in addition to these 6 types of characters, the document may contain, for example, Simplified Chinese characters, Traditional Chinese characters, and Korean letters, in which case the number of dimensions of the frequency vector is 9 or greater.

[0066] The document classification section **301** next identifies a document with the highest character count in each group **1** to N**1** generated in the filtering process **1** as a parent document (S**702**). The document classification section **301** then calculates a level of similarity between the frequency vector of the parent document in a group and the frequency vector of each non-parent document (child document) in the group (S**703**). If the levels of similarity fall in a prescribed range (YES in step S**704**), the document classification section **301** classifies the child documents into the same group as the parent document (S**705**).

[0067] As an example, assume that group **1** contains documents A to Z where document A has the highest character count. The document processing device **110** identifies document A as the parent document and calculates a level of similarity between the frequency vector of parent document A and the frequency vector of each child document B to Z in group **1**. If all the levels of similarity between parent document A and child documents B to R fall in a prescribed range, the document classification section **301** classifies documents A to R into group **1**-**1**.

[0068] The document classification section **301** calculates the level of similarity, for example, by measuring distance between the two frequency vectors (e.g., Manhattan distance or Euclidean distance). The level of similarity may be calculated by any method other than measuring distance between the two frequency vectors.

[0069] The document classification section **301** next identifies, in each group **1** to N**1**, a document with the highest character count of all those remaining child documents which were not classified into the same group as the parent document as a new parent document. The document classification section **301** then classifies the new parent document and the remaining child documents into the same group on the basis of the levels of similarity between the new parent document and the remaining child documents.

[0070] As an example, assume that document S has the highest character count of all remaining documents S to Z in group **1**. The document classification section **301** identifies document S as a new parent document and calculates a level of similarity between the frequency vector of parent document S and the frequency vector of each child document T to Z. If all the levels of similarity between parent document S and child documents T to V fall in a prescribed range, the document classification section **301** classifies documents S to V into group **1**-**2**.

[0071] The document classification section **301** repeats this classification process on each group **1** to N**1** so long as it is possible to carry out the classification process (YES in step S**706**). When the classification process can be no longer carried out (NO in step S**706**), the classification determination section **302** determines that there is no possibility that there is a near-duplicate document of the remaining document and excludes the remaining document from the filtering process **3** (S**707**).

[0072] As an example, assume that document W has the highest character count of all remaining documents W to Z in group **1**. The document classification section **301** identifies document W as a new parent document (S**702**) and calculates a level of similarity between the frequency vector of parent document W and the frequency vector of each child document X to Z (S**703**). If the level of similarity between parent document W and child document X falls in a prescribed range, the document classification section **301** classifies documents W and X into group **1**-**3** (S**705**).

[0073] On the other hand, if neither the level of similarity calculated using remaining document Y in group **1** as a parent document nor the level of similarity calculated using remaining document Z in group **1** as a parent document falls in a prescribed range (NO in step S**704**), the document classification section **301** determines that it is impossible to further divide the population into subgroups (NO in step S**706**), and the classification determination section **302** excludes documents Y and Z from the filtering process **3** (S**707**). The document processing device **110** further divides the groups generated in the filtering process **1** by performing this calculation on each group **1** to N**1**, to further classify the documents.

[0074] In other words, the filtering process **2** may be a classification process of obtaining the occurrence count of each character type in the two or more documents determined to be possible near duplicates to classify the two or more documents on the basis of the distribution of the occurrence counts. Hence, the document processing device **110** is capable of further classifying the documents on the basis of a tendency that documents in which the same type of characters appear at close frequencies have similar content.

Filtering Process **3**

[0075] FIG. **8** is a flow chart representing an example of the filtering process **3** implemented by the document processing device **110**. Steps S**801** to S**807** shown in FIG. **8** constitute at least part of step S**503** shown as an example in FIG. **5**.

[0076] The feature extraction section **303** first calculates a line frequency vector for a document to which the filtering process **3** is to be applied, to extract the line frequency vector as a feature of the document (S**801**). A line frequency vector is, for example, a vector containing, in each dimension thereof, a single line separated by a line break from the other lines. As an example, if a document contains a sentence, "This document (line break) is important," the document processing device **110** places "This document" in a first dimension of the line frequency vector and "is important." in a second dimension thereof.

[0077] The document classification section **301** next identifies a document with the highest line count in each group **1** to N**2** generated in the filtering process **2** as a parent document (S**802**). The document classification section **301** then calculates a level of similarity between the line frequency vector of the parent document in a group and the line frequency vector of each non-parent document (child document) in the group (S**803**). If the levels of similarity fall in a prescribed range (YES in step S**804**), the document classification section **301** classifies the child documents into the same group as the parent document (S**805**).

[0078] As an example, assume that group **1-1** contains documents A to R where document A has the highest line count. The document classification section **301** identifies document A as the parent document and calculates a level of similarity between the line frequency vector of parent document A and the line frequency vector of each child document B to R in group **1-1**. If all the levels of similarity between parent document A and child documents B to K fall in a prescribed range, the document classification section **301** classifies documents A to K into group **1-1-1**.

[0079] The document classification section **301** next identifies, in each group **1** to N**2**, a document with the highest line count of all those remaining documents which were not classified into the same group as the parent document as a new parent document. The document classification section **301** then further classifies the new parent document and the remaining child documents into the same group on the basis of the levels of similarity between the new parent document and the remaining child documents.

[0080] As an example, assume that document L has the highest line count of all remaining documents L to R in group **1-1**. The document classification section **301** identifies document L as a new parent document and calculates a level of similarity between the line frequency vector of parent document L and the line frequency vector of each child document M to R. If all the levels of similarity between parent document L and child documents M and N fall in a prescribed range, the document classification section **301** classifies documents L to N into group **1-1-2**.

[0081] The document classification section **301** repeats this classification process on each group **1** to N**2** so long as it is possible to carry out the classification process (YES in step S**806**). When the classification process can be no longer carried out (NO in step S**806**), the classification determination section **302** determines that there is no possibility that there is a near-duplicate document of the remaining document and excludes the remaining document from the filtering process **4** (S**807**).

[0082] As an example, assume that document O has the highest character count of all remaining documents O to R in group **1-1**. The document classification section **301** identifies document O as a new parent document (S**802**) and calculates a level of similarity between the line frequency vector of parent document O and the line frequency vector of each child document P to R (S**803**). If the level of similarity between parent document O and child document P falls in a prescribed range, the document classification section **301** classifies documents O and P into group **1-1-3** (S**805**).

[0083] On the other hand, neither the level of similarity calculated using remaining document Q in group **1-1** as a parent document nor the level of similarity calculated using remaining document R in group **1-1** as a parent document falls in a prescribed range (NO in step S**804**), the document classification section **301** determines that it is impossible to further divide the population into subgroups (NO in step S**806**), and the classification determination section **302** excludes documents Q and R from the filtering process **4** (S**807**). The document processing device **110** further divides the groups generated in the filtering process **2** by performing this calculation on each group **1** to N**2**, to further classify the documents.

[0084] In other words, the filtering process **3** may be a process of comparing the character string in each line between each pair of documents in the two or more documents determined to be possible near duplicates to classify the two or more documents on the basis of the results of the comparison. Hence, the document processing device **110** is capable of further classifying the documents on the basis of a tendency that documents with similar lines have similar content.

Filtering Process **4**

[0085] FIG. **9** is a flow chart representing an example of the filtering process **4** implemented by the document processing device **110**. Steps S**901** to S**908** shown in FIG. **9** constitute at least part of step S**504** shown as an example in FIG. **5**, and step S**909** is an equivalent of step S**505**.

[0086] The feature extraction section **303** first converts a document to which the filtering process **4** is to be applied to a hash value by using two types of hash functions to extract two hash values obtained through the conversion as a feature of the document (S**901**).

[0087] A first hash function is, for example, a function that takes character codes with five characters as an argument and returns a hash value of 0 to 3. A second hash function is, for example, a function that takes character codes with five characters as an argument and returns a hash value of 4 to 7. The number of characters of the character codes given to the hash functions may be variable. Additionally, the number of hash functions, the return values from the hash functions, and the range of the return values may be altered in any suitable manner.

[0088] As an example, the feature extraction section **303** gives the character codes that correspond to five characters from the first character (that is, the first to fifth characters) of the document to the first hash function and the second hash function to have two hash values returned. The feature extraction section **303** then gives the character codes that correspond to five characters from the second characters (that is, the second to sixth characters) of the document to the first hash function and the second hash function to have two hash values returned.

[0089] The feature extraction section **303** then continues likewise to give the character codes that correspond to next five characters of the document to the two types of hash functions to extract two hash values, by shifting the target character range by one character at a time. Therefore, the feature extraction section **303** obtains **2***x* (n-4) hash values if the document contains n characters.

[0090] The feature extraction section **303** next calculates the frequencies of 8 types of hash values in each document and generates a hash frequency vector (S**902**) to extract the hash frequency vector as a feature of that document. A hash frequency vector is a vector containing the frequency of a hash value (m-1) in the m-th dimension thereof.

[0091] The document classification section **301** subsequently calculates a total frequency that is a sum of the frequencies of all the types of hash values (S**903**). The document classification section **301** then identifies a document with the highest total frequency in each group **1** to N**3** generated in the filtering process **3** as a parent document (S**904**) and calculates a level of similarity between the hash frequency vector of the parent document in a group and the hash frequency vector of each non-parent document (child document) in the group (S**905**). If the levels of similarity fall in a prescribed range (YES in step S**906**), the document classification section **301** classifies the child documents into the same group as the parent document (S**907**).

[0092] As an example, assume that group **1-1-1** contains documents A to K where document A has the highest total frequency. The document classification section **301** identifies document A as a parent document and calculates a level of similarity between the hash frequency vector of parent document A and the hash frequency vector of each child document B to K in group **1-1-1**. If all the levels of similarity between parent document A and child documents B to D fall in a prescribed range, the document classification section **301** classifies documents A to D into group **1-1-1-1**.

[0093] The document classification section **301** next identifies, in each group **1** to N**3**, a document with the highest total frequency of all those remaining documents which were not classified into the same group as the parent document as a new parent document. The document classification section **301** then further classifies the new parent document and the remaining child documents into the same group on the basis of the levels of similarity between the new parent document and the remaining child documents.

[0094] As an example, assume that document E has the highest total frequency of all remaining documents E to K in group **1-1-1**. The document classification section **301** identifies document E as a new parent document and calculates a level of similarity between the hash frequency vector of parent document E and the hash frequency vector of each child document F to K. If all the levels of similarity between parent document E and child documents F and G fall in a prescribed range, the document classification section **301** classifies documents E to G into group **1-1-1-2**.

[0095] The document classification section **301** repeats this classification process on each group **1** to N**3** so long as it is possible to carry out the classification process (YES in step S**908**). When the classification process can be no longer carried out (NO in step S**908**), the detection section **304** detects a group containing a plurality of documents in classified groups **1** to N**4** (N**4** is a natural number) as a set of near-duplicate documents (S**909**).

[0096] As an example, assume that document H has the highest total frequency of all remaining documents H to K in group **1-1-1**. The document classification section **301** identifies document H as a new parent document (S**904**) and calculates a level of similarity between the hash frequency vector of parent document H and the hash frequency vector of each child document I to K (S**905**). If the level of similarity between parent document H and child document I falls in a prescribed range, the document classification section **301** classifies documents H and I into group **1-1-1-3** (S**907**).

[0097] On the other hand, neither the level of similarity calculated using remaining document J in group **1-1-1** as a parent document nor the level of similarity calculated using remaining document K in group **1-1-1** as parent document falls in a prescribed range (NO in step S**906**), the document classification section **301** determines that it is impossible to further divide the population into subgroups (NO in step S**908**), and the detection section **304** detects documents A to D, documents E to G, and documents H to I as sets of near-duplicate documents (S**909**).

[0098] The document processing device **110** further divides the groups generated in the filtering process **3** by performing this calculation on each group **1** to N**3**, to further classify the documents. Hence, the document processing device **110** is capable of further classifying the documents on the basis of a tendency that documents with close hash value frequencies have similar content. The document processing device **110** then detects groups containing a plurality of documents in groups **1** to N**4** classified in the filtering process **4** as a set of near-duplicate documents.

[0099] In other words, the filtering process **4** may be a classification process of converting characters in the two or more documents determined to be possible near duplicates into numerical values using prescribed functions, obtaining the occurrence count of each numerical value, to classify the two or more documents on the basis of the distribution of the occurrence counts.

[0100] As described above in detail with reference to FIGS. **6** to **9**, the document processing device **110** is capable of detecting near-duplicate documents by sequentially applying the filtering processes **1** to **4** to each document. The document processing device **110** can hence obtain review results for all near-duplicate documents without having to have reviewers review all the near-duplicate documents.

Amount of Calculation of Each Filtering Process

[0101] A description will be given of the amount of calculation for the document processing device **110** to apply the filtering processes **1** to **4** (plurality of classification processes) to a document.

[0102] As described earlier with reference to FIGS. **6** to **9**, the feature extraction section **303** extracts features **1** to **4** below of documents to be classified that match the filtering processes **1** to **4** in the document classification process:

[0103] 1. a quotient of the character count of the document divided by a prescribed character count, rounded down to a whole number;

[0104] 2. a frequency vector containing a character count of each type of characters that appears in the document in an associated dimension;

[0105] 3. a line frequency vector containing a line separated by a line break from the other lines in an associated dimension; and

[0106] 4. a hash frequency vector containing a frequency of each hash value of the document in an associated dimension.

[0107] The document classification section **301** then applies the filtering processes **1** to **4** that use these features to the documents to classify the documents.

[0108] In other words, an approximate amount of calculation in each filtering process can be obtained as a sum of the amount of calculation in the extraction of the features of the documents and the amount of calculation in the classification of the documents. The amount of calculation involved is smaller in the filtering process **3** than in the filtering process **4**, smaller in the filtering process **2** than in the filtering process **3**, and smaller in the filtering process **1** than in the filtering process **2**. In other words, the document classification section **301** sequentially applies these filtering processes in the ascending order of the amount of calculation.

[0109] Meanwhile, the classification determination section **302** excludes documents for which there is less likely a near-duplicate document upon the application of a filtering process that involves a smaller amount of calculation. Therefore, a filtering process that involves s larger amount of calculation is applied to a smaller number of documents.

[0110] For these reasons, the present embodiment requires a smaller amount of calculation for implementing the entire near-duplicate document detection process (see FIG. **5**) than conventional art. In other words, the document processing device **110** is capable of more quickly detecting near-duplicate documents than conventional art.

[0111] An example of the method for quickly detecting near-duplicate documents will be described. For instance, a single document containing by far the largest number of characters in a population is excluded from the filtering process **2** when the filtering process **1** is applied.

[0112] As another example, if two documents containing the same number of characters produce frequency vectors that have a low level of similarity therebetween (in other words, if the types of characters that appear in the two documents have different distributions), the two documents are classified into different groups. If either of the groups contains single document, this document is excluded from the filtering process **3** when the filtering process **2** is applied.

[0113] The document processing device **110** sequentially applies a plurality of filtering processes to each document in the ascending order of the amount of calculation involved in the filtering processes as detailed here. Documents for which there is less likely a near-duplicate document are therefore excluded from succeeding filtering processes earlier in the document classification process where the filtering process involves a smaller amount of calculation. The document processing device **110** is hence capable of more quickly detecting near-duplicate documents than conventional art where a single classification process is uniformly applied to all the documents.

[0114] The present embodiment has so far concretely described examples where the filtering processes **1** to **4** are used. Specific processing in each filtering process, the number of filtering processes, and other factors, however, are not limited to these examples, provided that an approach is taken where: a plurality of filtering processes that involve different amounts of calculation are sequentially applied to the population in the ascending order of the amount of calculation for classification of the documents; every time one of the filtering processes is applied, it is determined from the results of the classification whether or not there is a possibility that there are two or more similar documents in the population; and the application of a preceding filtering process is followed by the application of a succeeding filtering process to the two or more documents for which it is determined that there is such a possibility.

[0115] Accuracy in detecting near-duplicate documents in the present embodiment is as high as or higher than that in conventional art. As described above, since any specific processing may be implemented in each filtering process so long as the aforementioned approach is taken, for example, conventional filtering processes may be used in the present embodiment. In such cases, the detection accuracy at least does not fall.

[0116] The document processing device **110** is hence capable of improving the near-duplicate document detection speed without having to sacrifice detection accuracy. The document processing device **110** is also capable of, as described earlier, improving review efficiency by detecting near-duplicate documents. The document review system **100** is hence capable of further increasing the efficiency in having numerous documents reviewed by reviewers.

Additional Remarks

[0117] An aspect of the present disclosure is not limited to the embodiments and variation examples described above and may be implemented in various other forms. The configuration detailed above may be replaced by a practically identical configuration, a configuration that achieves the same effect and function, or a configuration that achieves the same purpose.

[0118] The document processing device **110** may be described as being, for example, a document processing device including: a document classification section for classifying a plurality of documents into a plurality of groups using a first classification process; and a classification determination section for determining whether or not each of the plurality of groups contains two or more documents, wherein the document classification section, after applying the first classification process, further classifies the two or more documents in each group evaluated as containing the two or more documents using a second classification process that differs from the first classification process, and the first classification process involves a smaller amount of calculation than the second classification process.

[0119] The document processing device **110** may alternatively be described as being, for example, a document processing device including: a document classification section for sequentially applying a plurality of classification processes that involve differ amounts of calculation to a plurality of documents in an ascending order of the amounts of calculation to classify the plurality of documents; and a classification determination section for, every time one of the plurality of classification processes is applied, determining based on a result of the classification whether or not there is a possibility that the plurality of documents includes two or more similar documents, wherein the document classification section, after applying a preceding one of the plurality of classification processes, applies a succeeding one of the plurality of classification processes to the two or more documents determined as being possibly similar.

[0120] A method of controlling a document processing device may be described as, for example, including: the classification step of applying a first classification process to a plurality of documents to classify the plurality of documents into a plurality of groups; the identifying step of, after the first classification process is applied, identifying a group containing two or more documents in the plurality of groups; and the fine classification step of applying a second classification process to the two or more documents in each group identified as containing the two or more documents, wherein: the identifying step, after a k-th classification process is applied (k is a natural number), identifies a group containing two or more documents in the plurality of groups; the fine classification step applies a (k+1)-th classification process to the two or more documents in each group identified as containing the two or more documents; and the k-th classification process involves a smaller amount of calculation than the (k+1)-th classification process.

Software Implementation

[0121] The control blocks of the document processing device **110** (particularly, each of the sections **301**, **302**, **303**, **304**, **305**, and **306** of the controller **200**) may be implemented by software run by a controller (processor) such as a CPU (central processing unit). Specifically, the document processing device **110** includes, among others: a CPU that executes instructions from control programs or software by which various functions are provided; a ROM (read-only memory) or like storage device (referred to as a "storage medium") containing the control programs and various data in a computer-readable (or CPU-readable) format and connected to the CPU; and a RAM (random access memory) into which the control programs are loaded and connected to the CPU. The computer (or CPU) then retrieves and runs the control programs contained in the storage medium, thereby achieving an example of the object of an aspect of the present disclosure. For example, the computer (or CPU) functions as the sections **301**, **302**, **303**, **304**, **305**, and **306** and executes the processes as shown in FIGS. **5**-**9**. The storage medium may be a "non-transitory, tangible medium" such as a tape, a disc/disk, a card, a semiconductor memory, or programmable logic circuitry. The control programs may be supplied to the computer via any transmission medium (e.g., over a communications network or by broadcasting waves) that can transmit the control programs. The present disclosure, in an aspect thereof, encompasses data signals on a carrier wave that are generated during electronic transmission of the control programs.

[0122] The control programs may be written in any programing language including script languages such as ActionScript and JavaScript®, object-oriented programing languages such as Objective-C and Java®, and markup languages such as HTML 5. The scope of the present disclosure further encompasses: information processing terminals (e.g., smartphones and personal computers) including various units having functions provided by the control programs; and document processing devices including various units having other necessary functions.

[0123] While there have been described what are at present considered to be certain embodiments of the invention, it will be understood that various modifications may be made thereto, and it is intended that the appended claim cover all such modifications as fall within the true spirit and scope of the invention.

What is claimed is:

1. A document processing device comprising:

a document classification section configured to sequentially apply a plurality of classification processes in a prescribed sequence to a plurality of documents to classify the plurality of documents into a plurality of groups; and

a classification determination section configured to every time one of the plurality of classification processes is applied, determine whether or not each group contains two or more documents, wherein

the document classification section, after applying a preceding one of the plurality of classification processes, applies a succeeding one of the plurality of classification processes to the two or more documents in each group determined as containing the two or more documents, and

the prescribed sequence is an ascending order of an amount of calculation involved in the plurality of classification processes.

2. The document processing device according to claim **1**, further comprising a detection section configured to detect, after a last one of the plurality of classification processes is applied to the two or more documents, a plurality of documents in a group as a set of similar documents.

3. The document processing device according to claim **1**, further comprising a feature extraction section configured to when each of the classification processes is applied, extract a common feature according to each of the classification processes from documents to be classified.

4. The document processing device according to claim **1**, wherein the document classification section uses, as one of the plurality of classification processes, a process of further classifying documents in each group determined as containing the two or more documents.

5. The document processing device according to claim **1**, wherein the document classification section uses, as one of the plurality of classification processes, a process of counting characters in each one of the plurality of documents to classify the plurality of documents based on a distribution of the character counts.

6. The document processing device according to claim **1**, wherein the document classification section uses, as one of the plurality of classification processes, a process of obtaining an occurrence count of each type of characters in the two or more documents to classify the two or more documents based on a distribution of the occurrence counts.

7. The document processing device according to claim **1**, wherein the document classification section uses, as one of the plurality of classification processes, a process of comparing a character string in each line of the two or more documents between each pair of documents in the two or more documents to classify the two or more documents based on a result of the comparison.

8. The document processing device according to claim **1**, wherein the document classification section uses, as one of the plurality of classification processes, a process of converting characters in the two or more documents to numerical values through a prescribed function and obtaining an occurrence count of each numerical value to classify the two or more documents based on a distribution of the occurrence counts.

9. A method of controlling a document processing device, the method comprising:

sequentially applying a plurality of classification processes in a prescribed sequence to a plurality of documents to classify the plurality of documents into a plurality of groups; and every time one of the plurality of classification processes is applied, determining whether or not each group contains two or more documents, wherein

in the classification of the plurality of documents into the plurality of groups, after applying a preceding one of the plurality of classification processes, the method applies a succeeding one of the plurality of classification processes to the two or more documents in each group determined as containing the two or more documents, and

the prescribed sequence is an ascending order of an amount of calculation involved in the plurality of classification processes.

10. A non-transitory computer-readable recording medium containing a control program that causes a computer to function as the document processing device according to claim **1**, the control program, when executed by the computer, causing the computer to function as the document classification section and the classification determination section.

* * * * *