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- (71) **Applicant:** UNIVERSITY-INDUSTRY COOPERATION GROUP OF KYUNG HEE UNIVERSITY [KR/KR]; 1732, Deogyong-daero, Giheung-gu, Yongin-si, Gyeonggi-do 446-701 (KR).
- (72) **Inventors:** LEE, Sung Young; 102-102, 25, Gumi-ro 144beon-gil, Bundang-gu, Seongnam-si, Gyeonggi-do 463-802 (KR). AFZAL, Muhammad; 1732, Deogyong-daero, Giheung-gu, Yongin-si, Gyeonggi-do 446-701 (KR).
- (74) **Agent:** KANG, Min Ki; 4th Fl., Seil Bldg., 58-5 Nonhyeon-Dong, Gangnam-gu, Seoul 135-010 (KR).

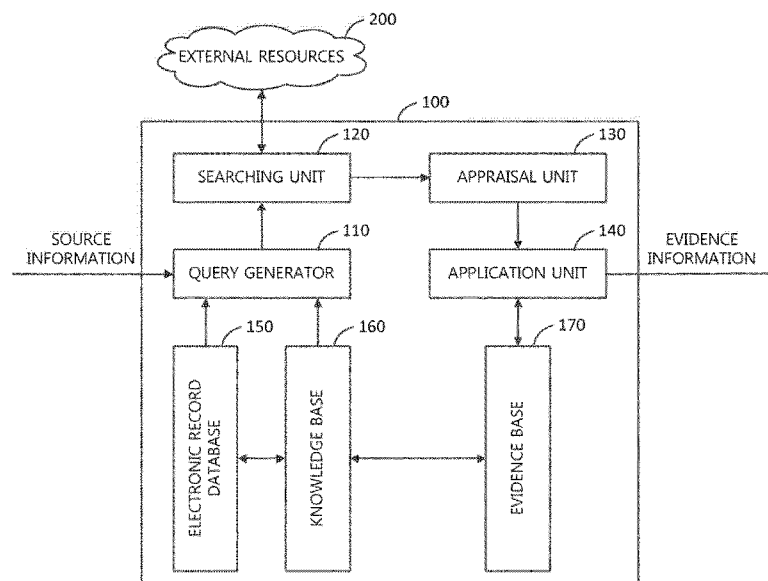
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(54) **Title:** CLINICAL DECISION SUPPORT SYSTEM AND METHOD FOR EVIDENCE ADAPTION USING EXTERNAL RESOURCES



(57) **Abstract:** A clinical decision support system using external resources includes a query generator generating input query information based on source information; a searching unit searching for external information that corresponds to the generated input query information from the external resources; an appraisal unit appraising the external information based on at least one selected from relevancy appraisal and validity appraisal; and an application unit using the appraised external information as evidence information that is used as a reference to the source information.

Description

Title of Invention: CLINICAL DECISION SUPPORT SYSTEM AND METHOD FOR EVIDENCE ADAPTION USING EXTERNAL RESOURCES

Technical Field

- [1] The inventive concept relates to a clinical decision support system and method for evidence adaption using external resources, and more particularly, to a clinical decision support system and method for evidence adaption using external resources which searches for information of the external resources based on query information that is used as a reference to electronic record information and rule information.

Background Art

- [2] The clinical decision support system (CDSS) may provide necessary knowledge to clinicians when the clinicians determine diagnosis or treatment methods for patients and guide the clinicians to accurate conclusions.
- [3] Also, during patient examination, the clinicians may not only rely on subjective decisions, but also access medically established guidelines through the CDSS by using a computer. Accordingly, the clinicians may be informed of clinical knowledge results that correspond to status of the patients. Thus, misdiagnosis may be prevented and relatively more objective medical treatment may be provided for the patients.
- [4] In addition, the CDSS may generate rule information (or clinical rule information) by logically analyzing clinical knowledge to provide clinical knowledge to the clinicians, and store the rule information in a knowledge base and use the stored rule information for decision making.
- [5] Furthermore, the CDSS may transform the clinical knowledge into query-based rule information by using a logical engine tool so that at least one selected from a clinician, a domain expert that provides clinical knowledge, and a system manager may generate, revise, renew, delete, or search for the rule information.
- [6] The clinical knowledge used in the CDSS may include empirical knowledge information of the clinicians and opinion information of domain experts, e.g., symptoms of a patient, treatment methods, and causes of diseases.
- [7] However, since the recent CDSS does not have a sufficient amount of clinical knowledge, reliability of decision making is decreasing. For example, although various diseases have emerged recently due to the outbreak of new viruses, treatment methods against the diseases are still inadequate.
- [8] Also, it is difficult to transfer a new treatment method to the CDSS in real-time as well as problematic to identify and verify the new treatment method.

- [9] In addition, when an existing previous treatment method is modified due to a rapid environmental change, it is difficult to identify and verify rule information that includes the existing treatment method again through the CDSS.

Disclosure of Invention

Technical Problem

- [10] The inventive concept provides a clinical decision support system and method for evidence adaption using external resources, which formulate the source information, which includes at least one selected from the rules information in the knowledge base and patient information in electronic health record database, in real time by using the external resources based information.
- [11] The inventive concept provides a clinical decision support system and method for evidence adaption using external resources, which generate standard terms from source information, generate query information that is used as a reference to the standard terms, and accelerate and improve accuracy of searching by adding synonyms that correspond to the query information.
- [12] The inventive concept provides a clinical decision support system and method for evidence adaption using external resources, which improves validation quality of source information by appraising external evidences that correspond to the source information by using relevancy and validity appraisals.

Solution to Problem

- [13] According to an aspect of the inventive concept, there is provided an evidence-adaptive clinical decision support system (CDSS) using external resources includes a query generator generating input query information based on source information; a searching unit searching for external information that corresponds to the generated input query information from the external resource; an appraisal unit appraising the external information based on at least one selected from relevancy appraisal and validity appraisal; and an application unit using the appraised external information as evidence information that is used as a reference to the source information.
- [14] The query generator may generate the input query information based on the source information for at least one selected from generating new rule information, modifying existing rule information, and requesting for clinical decision information.
- [15] The query generator may include a first generator extracting standard terms from the source information; a second generator generating query information that is used as a reference to the generated standard terms; and a third generator generating the input query information by adding synonyms that correspond to the generated query information.
- [16] The second generator may generate the query information that is used as a reference

to the standard terms extracted from at least one selected from electronic record information and rule information.

- [17] The system may further include an electronic record database that stores the electronic record information; and a knowledge base that stores the rule information, subject to the satisfaction of clinical decision.
- [18] The appraisal unit may extract matching frequency with respect to the source information from the external information, appraise relevancy of the external information based on the extracted matching frequency, and appraise validity of the external information based on a selection input of a domain expert.
- [19] The application unit may include an extractor sorting the appraised external information and extracting sorted external information as evidence information; and a generator generating at least one selected from hypothesis information and candidate rules information by performing data mining on the extracted evidence information.
- [20] The system may further include an evidence base that stores at least one selected from the evidence information, the hypothesis information, and the candidate rules information.
- [21] According to another aspect of the inventive concept, there is provided a clinical decision support method for evidence adaption using external resources generating input query information based on source information; searching for external information that corresponds to the generated input query information from the external resource; appraising the external information based on at least one selected from relevancy appraisal and validity appraisal; and using the appraised external information as evidence information that is used as a reference to the source information.
- [22] The generating of the input query information may include information based on the source information for at least one selected from generating new rule information, modifying existing rule information, and requesting for clinical decision information.
- [23] The generating of the input query information may include extracting standard terms from the source information; generating query information that is used as a reference to the generated standard terms; and generating the input query information by adding synonyms that correspond to the generated query information.
- [24] The using of the appraised external information as the evidence information may include sorting the appraised external information and extracting sorted external information as evidence information; and generating at least one selected from hypothesis information and candidate rules information by performing data mining on the extracted evidence information.

Advantageous Effects of Invention

- [25] According to an embodiment of the present invention, a clinical decision support

system (CDSS) may formulate source information, which includes at least one selected from rule information in knowledge base and patient information in electronic health record database, in real time by using external resources based external information.

[26] According to an embodiment of the present invention, the CDSS may generate standard terms from source information, generate query information that is used as a reference to the standard terms, and accelerate and improve accuracy of searching by adding synonyms that correspond to the query information.

[27] According to an embodiment of the present invention, the CDSS may improve validation quality of source information by appraising external evidences that correspond to the source information by using relevancy and validity appraisals.

Brief Description of Drawings

[28] FIG. 1 is a block diagram of a clinical decision support system (CDSS) for evidence adaption using external resources according to a first embodiment of the present invention;

[29] FIG. 2 is a block diagram of a query generator of the CDSS using the external resources according to the first embodiment of the present invention;

[30] FIG. 3 is a block diagram of an application unit of the CDSS using the external resources according to the first embodiment of the present invention;

[31] FIG. 4 is a block diagram of a CDSS using external resources according to a second embodiment of the present invention;

[32] FIG. 5 is a flowchart of a clinical decision support method for evidence adaption using external resources according to an embodiment of the present invention;

[33] FIG. 6 is a flowchart of a method of generating input query information in the clinical decision support method using the external resources, according to an embodiment of the present invention; and

[34] FIG. 7 is a flowchart of a method of using evidence information in the clinical decision support method for evidence adaption using the external resources, according to an embodiment of the present invention.

Mode for the Invention

[35] Hereinafter, one or exemplary embodiments of the present invention will be described in detail with reference to the accompanying drawings. However, the present invention is not limited to the exemplary embodiments.

[36] In the description, certain detailed explanations of the related art are omitted when it is deemed that they may unnecessarily obscure the essence of the inventive concept. Also, the terminology in the present specification is used to appropriately describe the embodiments of the present invention. The terminology may vary according to intentions of users or operators or practice of the field to which the embodiments of the

present invention pertains. Therefore, the definition of the terminology should be determined based on the specification.

[37] FIG. 1 is a block diagram of a clinical decision support system (CDSS) 100 for evidence adaption using external resources 200 according to a first embodiment of the present invention.

[38] Referring to FIG. 1, the CDSS 100 may include a query generator 110, a searching unit 120, an appraisal unit 130, and an application unit 140.

[39] The query generator 110 may generate input query information based on source information. The source information may include at least one selected from rule information in knowledge base and patient information in electronic health record database.

[40] For example, the query generator 110 may generate the input query information based on source information for at least one selected from the rule information in knowledge base and patient information in electronic health record database at three different occasions; new rule creation, existing rule modification, or clinical decision requesting

[41] The new rule information may include information regarding a new treatment method created based on empirical knowledge information of clinicians and opinion information of domain experts, e.g., symptoms of a patient, treatment methods, and causes of diseases.

[42] The existing rule information may include information regarding an existing treatment method created based on the empirical knowledge information of the clinicians and the opinion information of the domain experts. The modified existing rule information may include information regarding improvement measures of the existing treatment method.

[43] The query generator 110 may include elements for generating the source information as the input query information. Hereinafter, the elements of the query generator 110 will be described in detail with reference to FIG. 2.

[44] FIG. 2 is a block diagram of the query generator 110 of the CDSS 100 using the external resources 200 according to the first embodiment of the present invention.

[45] Referring to FIG. 2, the query generator 110 may include a first generator 111, a second generator 112, and a third generator 113.

[46] The first generator 111 may extract standard terms from the source information. Specifically, the first generator 111 may extract the standard terms, which are used as a standard in clinics, from atypical source information.

[47] Also, the first generator 111 may extract the standard terms from at least one selected from electronic record information and rule information which correspond to the atypical source information.

- [48] The electronic record information may include an electronic medical record (EMR) and an electronic health record (EHR). In detail, the EMR may include electronically processed information regarding a medical treatment of a patient recorded by a medical institution, and the EHR may include information related to medical treatments of the patient recorded by medical institutions and combined/shared via a network.
- [49] The rule information may be clinical knowledge created based on the empirical knowledge information of the clinicians and the opinion information of the domain experts.
- [50] According to an embodiment of the present invention, the first generator 111 may extract the standard terms from rule information that corresponds to the source information. However, when there is no rule information that corresponds to the source information, the first generator 111 may extract the standard terms from electronic record information that corresponds to the source information.
- [51] The second generator 112 may generate query information that is used as a reference to the generated standard terms. In detail, the second generator 112 may generate the query information that is used as a reference to the standard terms extracted from at least one selected from the electronic record information and the rule information.
- [52] A format of the query information may be a structurally systemized programming language for searching (or inquiring) and browsing found results, or Arden Syntax encoded Medical Logic Module (MLM).
- [53] The third generator 113 may generate input query information by adding synonyms that correspond to the generated query information. In detail, the third generator 113 may generate the input query information by adding synonyms that correspond to the generated query information by using an electronic dictionary. The electronic dictionary may arrange synonyms of words used in the query information in a predetermined order.
- [54] The input query information may be provided in a Systematized Nomenclature of Medicine-Clinical Terms (SNOMED CT) format.
- [55] SNOMED CT is a standard medical term system created by combining SNOMED Reference Terminology (SNOMED RT), developed by the College of American Pathologists (CAP), and the Clinical Terms Version 3 (CTV3) (known as Read codes), developed by the National Health Service of the United Kingdom (NHS).
- [56] Also, SNOMED CT is a terminology system based on medical principles, and satisfies conditions required for medical terminologies. SNOMED CT includes 14 top hierarchies, and each top hierarchy includes various granularities.
- [57] Referring back to FIG. 1, the CDSS 100 may additionally include an electronic record database 150 that stores the electronic record information, a knowledge base 160 that stores the rule information, and an electronic dictionary database (not shown)

that stores the electronic dictionary.

[58] Alternatively, the CDSS 100 may include a combination database (not shown) that stores the electronic record information, the rule information, and the electronic dictionary.

[59] According to an embodiment of the present invention, the query generator 110 may generate the input query information based on at least one selected from the electronic record database 150 and the knowledge base 160 which are connected to an external system.

[60] The external system may include at least one selected from a system of a predetermined institution, a system of a public institution supporting decisions of a plurality of medical institutions, and a system of a company supporting decisions of the plurality of medical institutions.

[61] The searching unit 120 may search for external information that corresponds to the generated input query information from the external resources 200.

[62] The external resources 200 may include online resources, for example, an online academic database, academic websites, and a search engine database, which are related to clinical knowledge.

[63] For example, the external resources 200 may include PubMed and Medical Literature Analysis and Retrieval System Online (MEDLINE).

[64] PubMed is a searching service over MEDLINE databases that include clinical knowledge related to at least one selected from medical science, life science, veterinary science, and biomedical science.

[65] According to an embodiment of the present invention, the searching unit 120 may select an online resource of a clinical field corresponding to the source information from the external resources 200, transform the input query information into Uniform Resource Locators (URLs), and search for external information that corresponds to the URLs via interface connected to the selected online resource.

[66] Also, the searching unit 120 may select a plurality of online resources, provide an interface that is combined and connected to the selected online resources, and sequentially search for external information that corresponds to the URLs based on a schedule policy.

[67] The appraisal unit 130 may appraise the external information based on at least one selected from relevancy appraisal and validity appraisal.

[68] According to an embodiment of the present invention, the appraisal unit 130 may extract matching frequency with respect to the source information from the external information, and appraise relevancy of the external information based on the extracted matching frequency.

[69] For example, the appraisal unit 130 may appraise relevancy based on matching

frequency that includes a distribution of relevant keywords between the source information and the external information.

[70] According to another embodiment of the present invention, the appraisal unit 130 may appraise validity of the external information based on a selection input of a domain expert.

[71] For example, the domain expert may analyze validity between the source information and the external information, and then determine ranks. The appraisal unit 130 may appraise the validity of the external information based on a selection input of the ranking.

[72] The application unit 140 may use the appraised external information as evidence information that is used as a reference to the source information. Hereinafter, elements of the application unit 140 will be described in detail with reference to FIG. 3.

[73] FIG. 3 is a block diagram of the application unit 140 of the CDSS 100 using the external resources 200 according to the first embodiment of the present invention.

[74] Referring to FIG. 3, the application unit 140 may include an extractor 141 and a generator 142.

[75] The extractor 141 may sort the appraised external information and extract sorted external information as the evidence information. For example, the extractor 141 may sort the appraised external information and extract the sorted the evidence information based on the source information that includes at least one selected from the rules information in the knowledge base and electronic health record database.

[76] The generator 142 may generate at least one selected from hypothesis information and candidate rules information by performing data mining on the extracted evidence information.

[77] The hypothesis information may be valid reference information of the source information. The CDSS 100 may support efficient decisions by referring to the hypothesis information.

[78] The candidate rules information may be obtained from the external information to create the new rule or modify an existing rule.

[79] According to an embodiment of the present invention, the generator 142 may use the extracted evidence information to generate at least one selected from the hypothesis information and the candidate rules information based on a selection input of a domain expert.

[80] For example, the generator 142 may categorize and model the extracted evidence information, provide the modeled evidence information to a domain expert, and detect a response information selection input of the domain expert.

[81] According to exemplary embodiments, the CDSS 100 may additionally include an evidence base 170 that stores at least one selected from the evidence information, the

hypothesis information, and the candidate rules information.

[82] FIG. 4 is a block diagram of a CDSS 400 using external resources according to a second embodiment of the present invention.

[83] Referring to FIG. 4, the CDSS 400 may include a query formulation unit 410, a query augments 420, an evidence searching unit 430, an evidence appraisal unit 450, an evidence application unit 460, an EMR/EHR database 470, a knowledge base 480, and an evidence base 490.

[84] The query formulation unit 410 may generate query information based on source information.

[85] For example, the query formulation unit 410 may generate input query information based on source information for at least one selected from the rules information in knowledge base and patient cases in electronic health record database at the time of new rule information, modifying existing rule information, and requesting for clinical decision information.

[86] According to an embodiment, the query formulation unit 410 may include a standardization unit 411, a query generator 412, a case loader 414, a rule fetcher 415, and a query editor 416.

[87] The standardization unit 411 may generate standard terms from the source information. Specifically, the standardization unit 411 may generate standard terms, which are used as a standard in clinics, from atypical source information.

[88] The query generator 412 may generate query information that is used as a reference to the generated standard terms. Specifically, the query generator 412 may generate query information that is used as a reference to the standard terms extracted from at least one selected from electronic record information and rule information.

[89] The case loader 414 may extract electronic record information that corresponds to the standard terms, and the rule fetcher 415 may extract rule information that corresponds to the standard terms.

[90] The query editor 416 may generate query information that is used as a reference to the standard terms extracted from at least one selected from the electronic record information and the rule information.

[91] The query augments 420 may generate input query information by adding synonyms that correspond to the generated query information.

[92] According to an embodiment, the query augments 420 may include a context adder 421, a synonym augments 422, and a synonym dictionary 423.

[93] The context adder 421 may transform the query information into a structurally systemized programming language or Arden Syntax encoded MLM.

[94] The synonym augments 422 may add synonyms that correspond to the generated query information by using the synonym dictionary 423 to generate the input query in-

formation.

- [95] The synonym dictionary 423 may arrange synonyms of words used in the query information in a predetermined order.
- [96] According to an embodiment of the present invention, the context adder 421 may transform the input query information into a structurally systemized programming language or Arden Syntax encoded MLM.
- [97] According to another embodiment of the present invention, the context adder 421 may transform the input query information into a SNOMED CT format.
- [98] The evidence searching unit 430 may search for external information that corresponds to the generated input query information from the external resource.
- [99] The external resources may include online resources, for example, an online academic database, academic websites, and a search engine database, which are related to clinical knowledge.
- [100] According to an embodiment, the evidence searching unit 430 may include a resource selector 431, a URL generator 432, a scheduler 433, and a searching interface 434.
- [101] The resource selector 431 may select an online resource a clinical field corresponding to the source information from the external resources. Also, the resource selector 431 may select a plurality of online resources of a clinical field corresponding to the source information from the external resources.
- [102] The URL generator 432 may transform the input query information into URLs, and the scheduler 433 may sequentially arrange the URLs based on a schedule.
- [103] The searching interface 434 may provide an environment for searching the sequentially arranged URLs, and sequentially search for external information that corresponds to the URLs based on the schedule.
- [104] According to an embodiment of the present invention, the CDSS 400 may include an interface provider (PubMed) 440 that provides an interface connected to the selected online resource.
- [105] The interface provider 440 may provide an interface connected to the plurality of selected online resources, and sequentially search for external information that corresponds to the URLs based on the schedule.
- [106] The evidence appraisal unit 450 may appraise the external information based on at least one selected from relevancy appraisal and validity appraisal.
- [107] According to an embodiment, the evidence appraisal unit 450 may include a relevancy checker 451 and a validity ranker 452.
- [108] The relevancy checker 451 may extract matching frequency with respect to the source information from the external information, and appraise relevancy of the external information based on the extracted matching frequency.

- [109] For example, the relevancy checker 451 may appraise relevancy based on matching frequency that includes a distribution of relevant keywords between the source information and the external information.
- [110] The validity ranker 452 may appraise validity of the external information based on a selection input of a domain expert.
- [111] For example, the domain expert may analyze validity between the source information and the external information, and then determine ranks. The validity ranker 452 may appraise the validity of the external information based on a selection input of the ranking.
- [112] The evidence application unit 460 may use the appraised external information as evidence information that is used as a reference to the source information.
- [113] According to an embodiment, the evidence application unit 460 may include an information extractor 461, a model generator 462, a hypothesis/rule generator 463, and a metadata manager 464. The information extractor 461 may sort the appraised external information and extract the sorted external information as the evidence information. For example, the information extractor 461 may sort the appraised external information and extract the sorted external information as the evidence information of the source information that includes at least one selected from the new rule information, the modified existing rule information, and the clinical decision information.
- [114] The model generator 462 may provide a model for performing data mining on the extracted evidence information. The hypothesis/rule generator 463 may generate at least one selected from hypothesis information and candidate rules information by performing data mining on the extracted evidence information.
- [115] The hypothesis information may be valid reference information of the source information. The CDSS 400 may support efficient decisions by referring to the hypothesis information.
- [116] The candidate rules information may be obtained by modifying at least one selected from the new rule information and the existing rule information by using the evidence information, or the new rule information.
- [117] According to an embodiment of the present invention, the hypothesis/rule generator 463 may use the extracted evidence information to generate at least one selected from the hypothesis information and the candidate rules information based on a selection input of a domain expert. The metadata manager 464 may transform at least one selected from the evidence information, the hypothesis information, and the candidate rules information into metadata and manage the metadata.
- [118] The EMR/EHR database 470 may store electronic record information, the knowledge base 480 may store the rule information, and the evidence base 490 may store the metadata.

- [119] According to an embodiment, the query formulation unit 410 may generate the input query information based on at least one selected from the EMR/EHR database 470 and the knowledge base 480 which are connected to an external system.
- [120] The external system may include at least one selected from a system of a pre-terminated institution, a system of a public institution supporting decisions of a plurality of medical institutions, and a system of a company supporting decisions of the plurality of medical institutions.
- [121] FIG. 5 is a flowchart of a clinical decision support method for evidence adaption using external resources according to an embodiment of the present invention.
- [122] Referring to FIG. 5, a CDSS may generate input query information based on source information. The source information may include at least one selected from new rule information, existing rule information, modified existing rule information, and clinical decision information.
- [123] In operation 510, the CDSS may generate input query information based on source information for at least one selected from generating the new rule information, modifying the existing rule information, and requesting for the clinical decision information.
- [124] The new rule information may include information regarding a new treatment method created based on empirical knowledge information of clinicians and opinion information of domain experts, e.g., symptoms of a patient, treatment methods, and causes of diseases.
- [125] The existing rule information may include information regarding an existing treatment method created based on the empirical knowledge information of the clinicians and the opinion information of the domain experts. The modified existing rule information may include information regarding improvement measures of the existing treatment method. Hereinafter, operation 510 will be described in detail with reference to FIG. 6.
- [126] FIG. 6 is a flowchart of a method of generating the input query information in the clinical decision support method using the external resources, according to an embodiment of the present invention.
- [127] Referring to FIG. 6, in operation 610, the CDSS may generate standard terms from the source information. Specifically, in operation 610, the CDSS may generate the standard terms that are used as a standard in clinics from atypical source information.
- [128] In operation 610, the CDSS may extract the standard terms, which are used as a standard in clinics, from at least one selected from electronic record information and rule information which correspond to the atypical source information.
- [129] The electronic record information may include an EMR and an EHR. In detail, the EMR may include electronically processed information regarding a medical treatment

of a patient recorded by a medical institution, and the EHR may include information that is related to medical treatments of a patient recorded by medical facilities and combined/shared via a network.

[130] The rule information may be clinical knowledge created based on the empirical knowledge information of the clinicians and the opinion information of the domain experts.

[131] In operation 610, the CDSS may extract the standard terms from rule information that corresponds to the source information. However, when there is no rule information that corresponds to the source information, the CDSS may extract the standard terms from electronic record information that corresponds to the source information.

[132] In operation 620, the CDSS may generate query information that is used as a reference to the generated standard terms. In detail, the CDSS may generate query information that is used as a reference to the standard terms extracted from at least one selected from the electronic record information and the rule information.

[133] In operation 630, the CDSS may generate input query information by adding synonyms that correspond to the generated query information. In detail, the CDSS may add synonyms that correspond to the generated query information by using an electronic dictionary to generate the input query information.

[134] The electronic dictionary may arrange synonyms of words used in the query information in a predetermined order

[135] Referring back to FIG. 5, the CDSS may further include storing the electronic record information, storing the rule information, and storing the electronic dictionary.

[136] In operation 520, the CDSS may search for external information that corresponds to the generated input query information from the external resources.

[137] The external resources may include online resources, for example, an online academic database, academic websites, and a search engine database, which are related to clinical knowledge.

[138] In operation 520, the CDSS may select an online resource of a clinical field corresponding to the source information from the external resources, transform the input query information into URLs, and search for external information that corresponds to the URLs via interface connected to the selected online resource.

[139] In operation 530, the CDSS may appraise the external information based on at least one selected from relevancy appraisal and validity appraisal. According to an embodiment of the present invention, in operation 530, the CDSS may extract matching frequency with respect to the source information from the external information, and appraise relevancy of the external information based on the extracted matching frequency. Also, in operation 530, the CDSS may appraise validity of the external information based on a selection input of a domain expert.

- [140] In operation 540, the CDSS may use the appraised external information as evidence information that is used as a reference to the source information. Hereinafter, operation 540 will be described in detail with reference to FIG. 7. FIG. 7 is a flowchart of a method of using evidence information in the clinical decision support method for evidence adaption using the external resources according to an embodiment of the present invention. Referring to FIG. 7, in operation 710, the CDSS may sort the appraised external information and extract the sorted external information as evidence information.
- [141] In operation 710, the CDSS may sort the appraised external information and extract the sorted external information as the evidence information of the source information that includes at least one selected from the new rule information, the modified existing rule information, and the clinical decision information.
- [142] In operation 720, the CDSS may generate at least one selected from hypothesis information and candidate rules information by performing data mining on the extracted evidence information.
- [143] The hypothesis information may be valid reference information of the source information. The CDSS may support efficient decisions by referring to the hypothesis information.
- [144] The candidate rules information may be obtained from external resources to create a new rule or modify an existing rule.
- [145] In operation 720, the CDSS may use the extracted evidence information to generate at least one selected from the hypothesis information and the candidate rules information based on a selection input of a domain expert.
- [146] The methods according to the exemplary embodiments may be implemented through program instructions that are executable via various computer devices and recorded in computer-readable recording media. The computer-readable recording media may include program instructions, data files, data structures or a combination thereof. The program instructions may be specifically designed for the present inventive concept or well-known to one of ordinary skill in the art of computer software. Examples of the computer-readable recording media include magnetic media (e.g., hard disks, floppy disks, or magnetic tapes), optical media (e.g., CD-ROMs or DVDs), magneto-optical media (e.g., floptical disks), and hardware devices specifically designed to store and execute the program instructions (e.g., ROM or RAM). Examples of the program instructions not only include machine codes that are made by compilers but also computer-executable high level language codes that may be executed by using an interpreter. The hardware devices may be configured to operate as one or more software modules for performing operations of the exemplary embodiments, and vice versa.
- [147] While the inventive concept has been particularly shown and described with

reference to exemplary embodiments thereof, it will be understood by one of ordinary skill in the art that various changes in form and details may be made therein without departing from the spirit and scope of the following claims. For example, appropriate results may be obtained even when technologies described above are executed in an order different from the description, and/or the elements, e.g., systems, structures, apparatuses, and circuits, are combined in a form different from the description, or replaced with different elements or equivalents thereof. Therefore, descriptions of features or aspects within each exemplary embodiment should typically be considered as available for other similar features or aspects in other exemplary embodiments.

Claims

- [Claim 1] A clinical decision support system and evidence adaption using external resources, the system comprising:
a query generator generating input query information based on source information;
a searching unit searching for external information that corresponds to the generated input query information from the external resources;
an appraisal unit appraising the external information based on at least one selected from relevancy appraisal and validity appraisal; and
an application unit using the appraised external information as evidence information that is used as a reference to the source information.
- [Claim 2] The system of claim 1, wherein the query generator generates the input query information based on the source information for at least one selected from generating new rule information, modifying existing rule information, and requesting for clinical decision information.
- [Claim 3] The system of claim 1, wherein the query generator comprises:
a first generator extracting standard terms from the source information;
a second generator generating query information that is used as a reference to the generated standard terms; and
a third generator generating the input query information by adding synonyms that correspond to the generated query information.
- [Claim 4] The system of claim 3, wherein the second generator generates the query information that is used as a reference to the standard terms extracted from at least one selected from electronic record information and rule information.
- [Claim 5] The system of claim 4, further comprising:
an electronic record database that stores the electronic record information; and
a knowledge base that stores the rule information.
- [Claim 6] The system of claim 1, wherein the appraisal unit extracts matching frequency with respect to the source information from the external information, and appraises relevancy of the external information based on the extracted matching frequency.
- [Claim 7] The system of claim 1, wherein the appraisal unit appraises validity of the external information based on a selection input of a domain expert.
- [Claim 8] The system of claim 1, wherein the application unit comprises:
an extractor sorting the appraised external information and extracting

sorted external information as evidence information; and
a generator generating at least one selected from hypothesis information and candidate rules information by performing data mining on the extracted evidence information.

[Claim 9] The system of claim 8, further comprising an evidence base that stores at least one selected from the evidence information, the hypothesis information, and the candidate rules information.

[Claim 10] A clinical decision support method for evidence adaption using external resources, the method comprising:
generating input query information based on source information;
searching for external information that corresponds to the generated input query information from the external resources;
appraising the external information based on at least one selected from relevancy appraisal and validity appraisal; and
using the appraised external information as evidence information that is used as a reference to the source information.

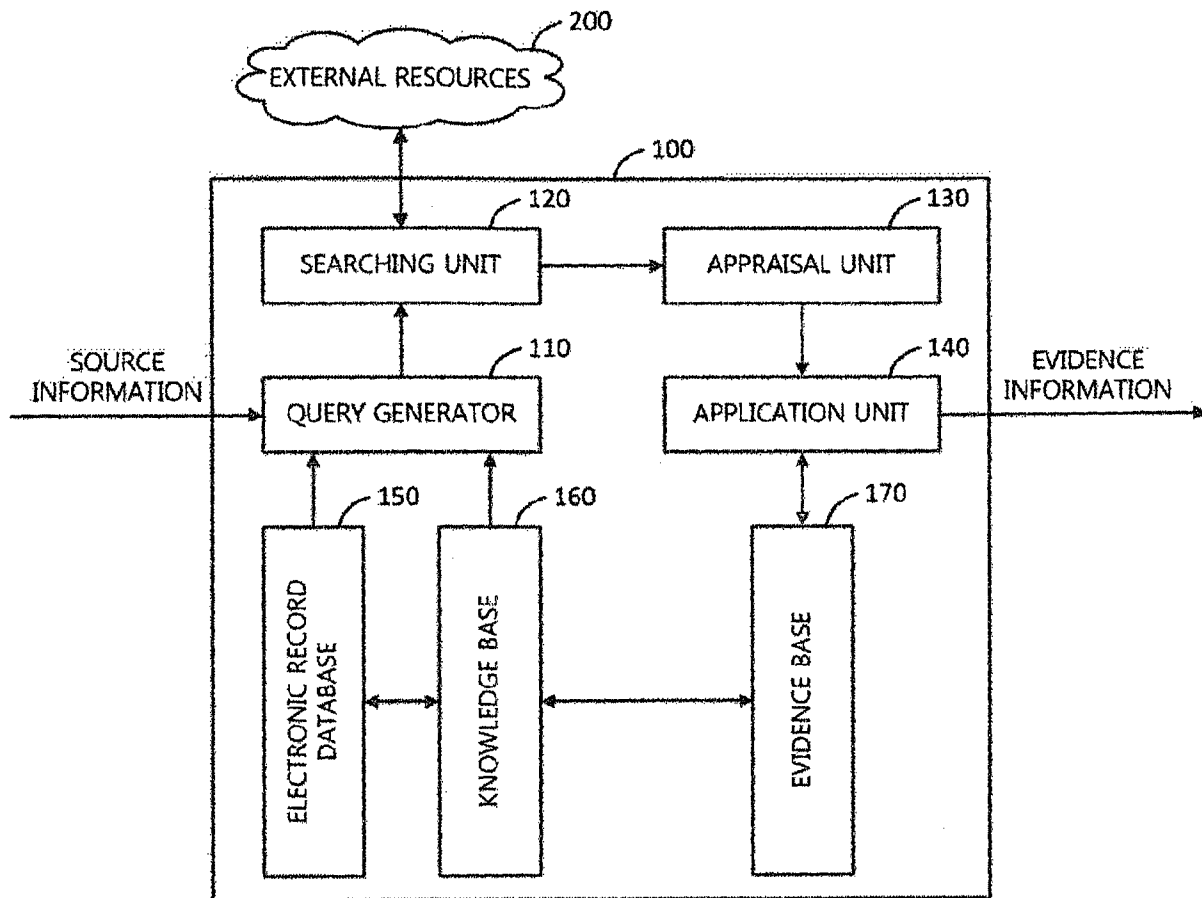
[Claim 11] The method of claim 10, wherein the generating of the input query information comprises generating the input query information based on the source information for at least one selected from generating new rule information, modifying existing rule information, and requesting for clinical decision information.

[Claim 12] The method of claim 10, wherein the generating of the input query information comprises:
extracting standard terms from the source information;
generating query information that is used as a reference to the generated standard terms; and
generating the input query information by adding synonyms that correspond to the generated query information.

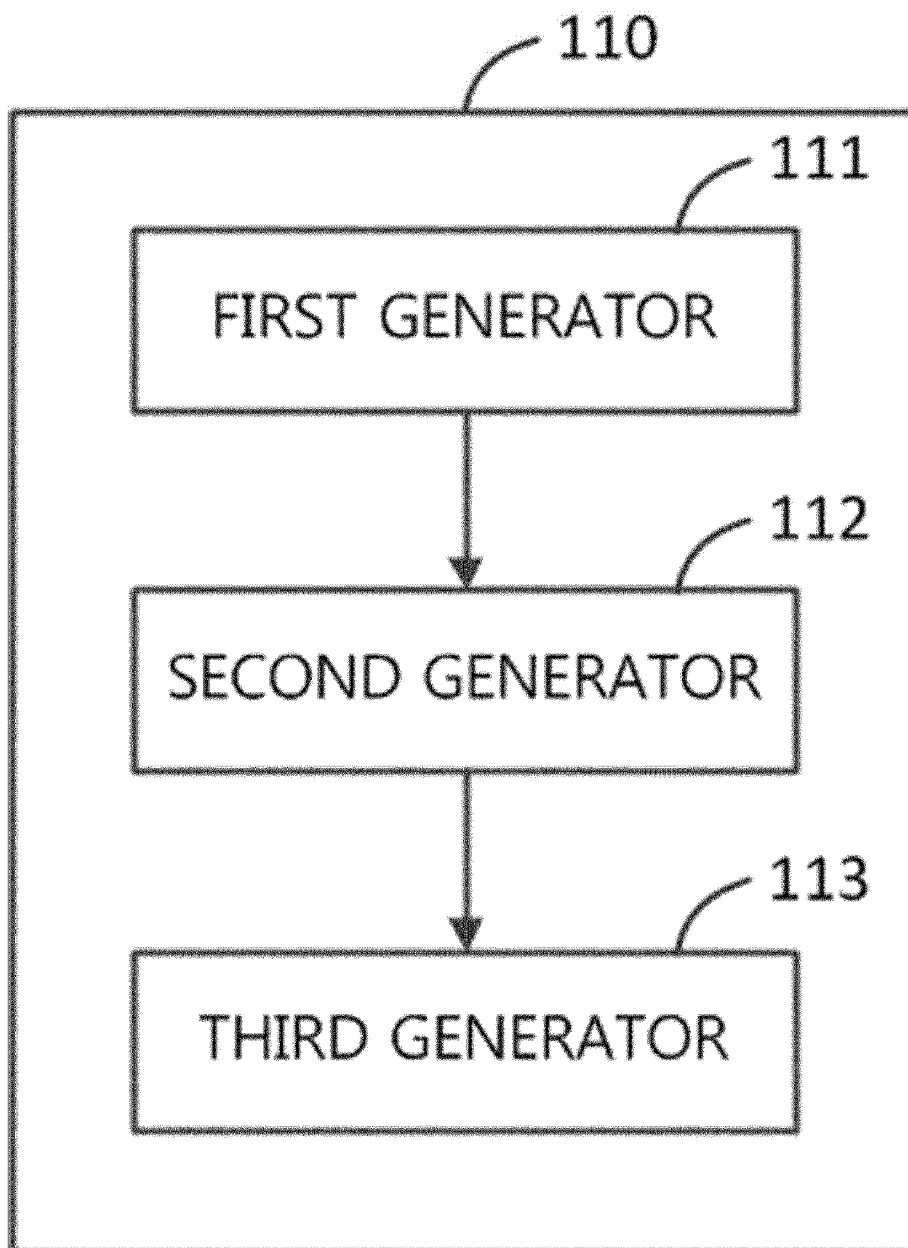
[Claim 13] The method of claim 10, wherein the using of the appraised external information as the evidence information comprises:
sorting the appraised external information and extracting sorted external information as evidence information; and
generating at least one selected from hypothesis information and candidate rules information by performing data mining on the extracted evidence information.

[Claim 14] A non-transitory computer-readable recording medium having recorded thereon a program, which, when executed by a computer, performs the method of any one of claims 10 to 13.

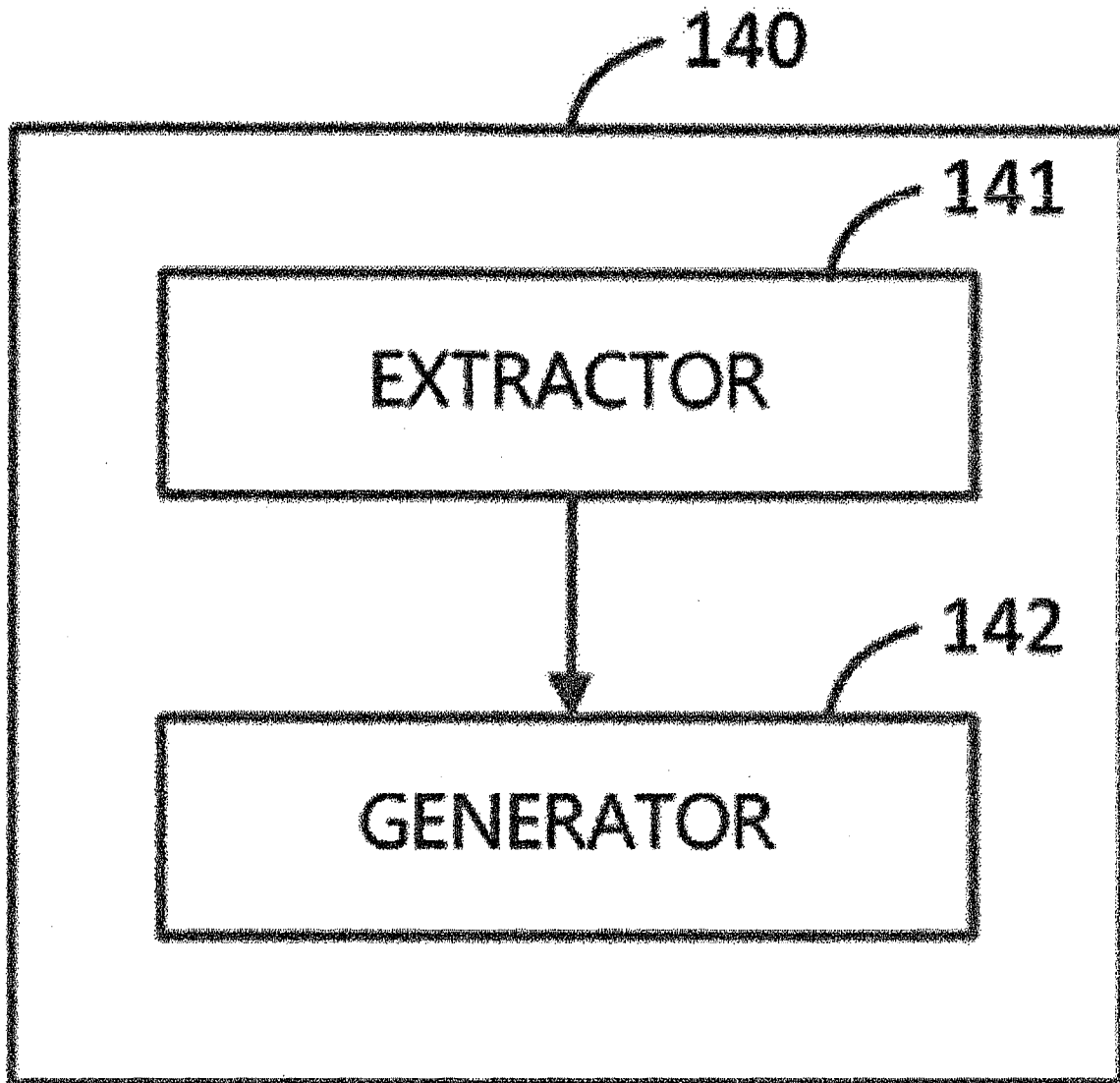
[Fig. 1]



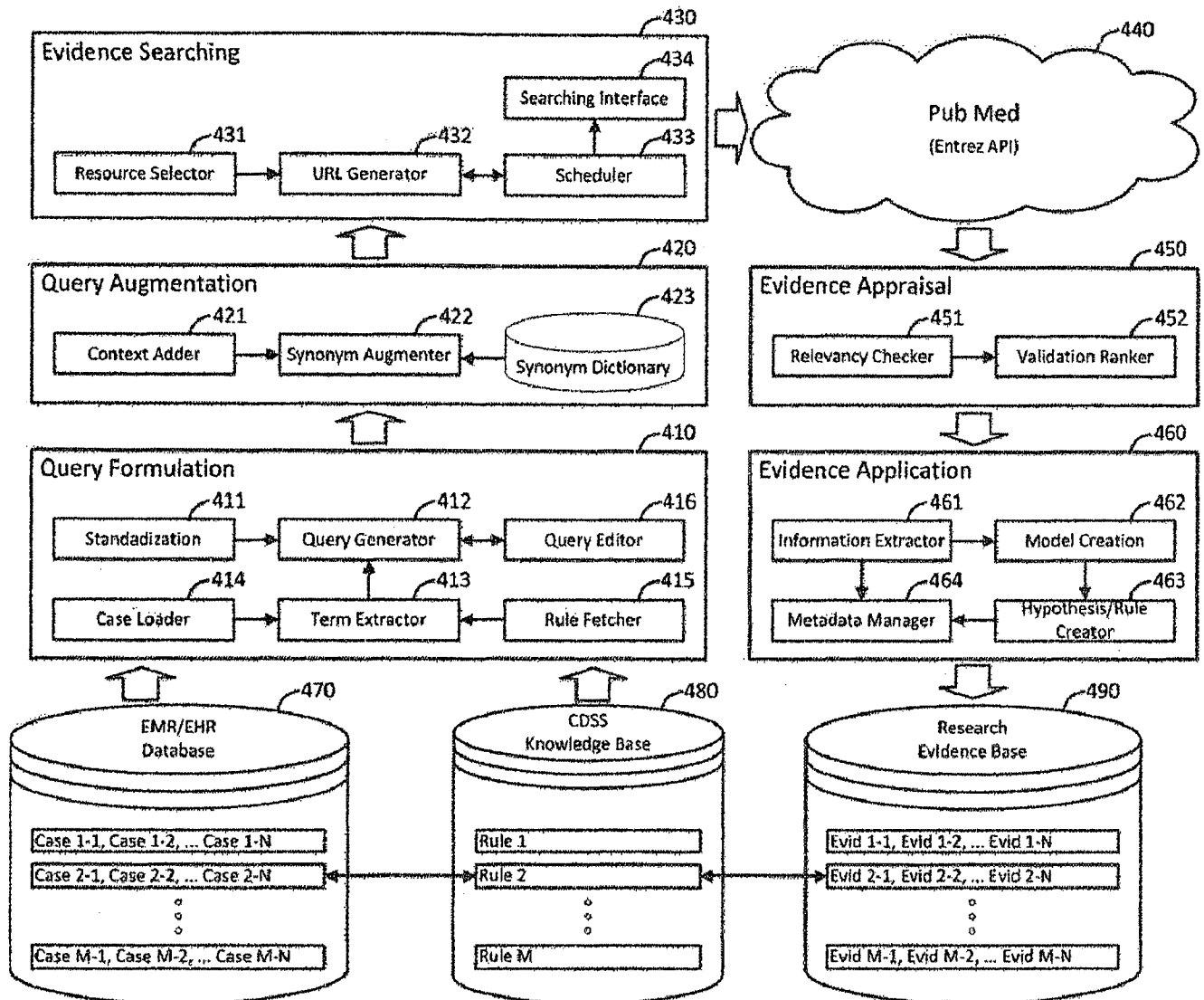
[Fig. 2]



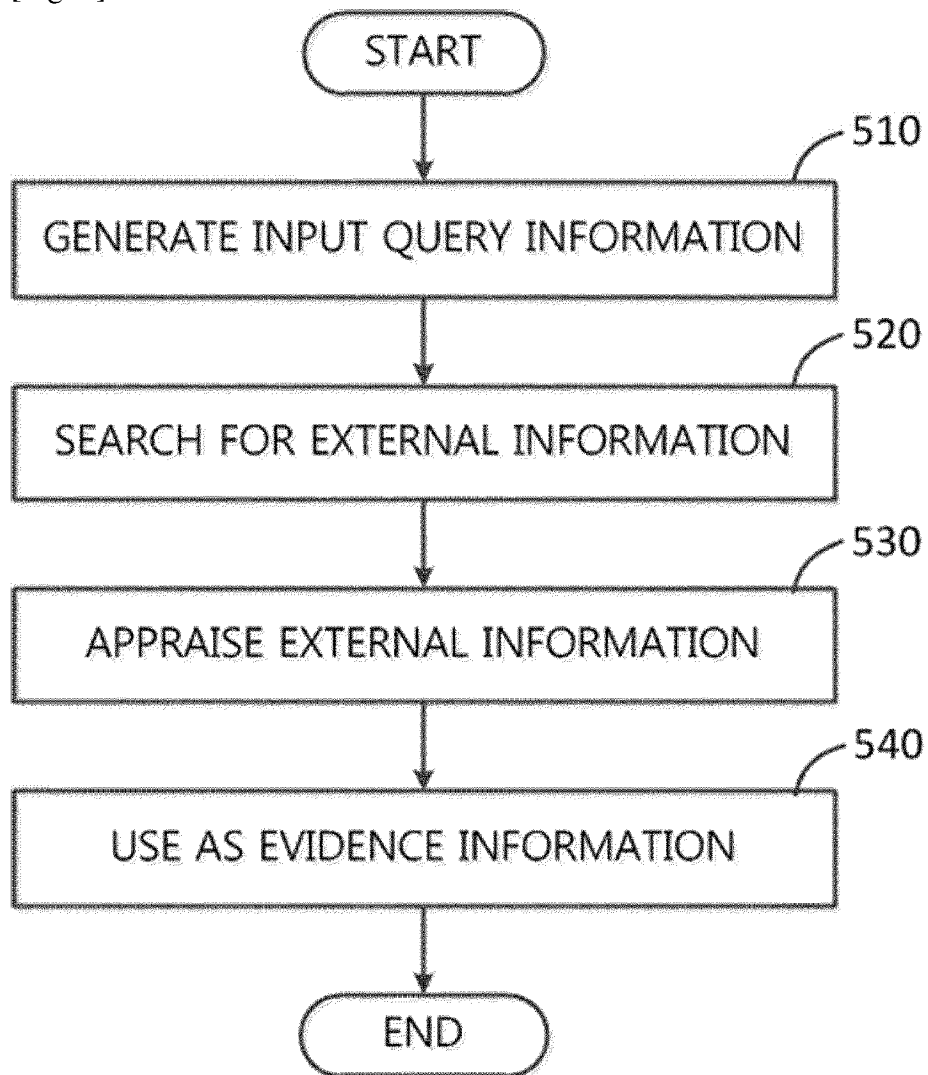
[Fig. 3]



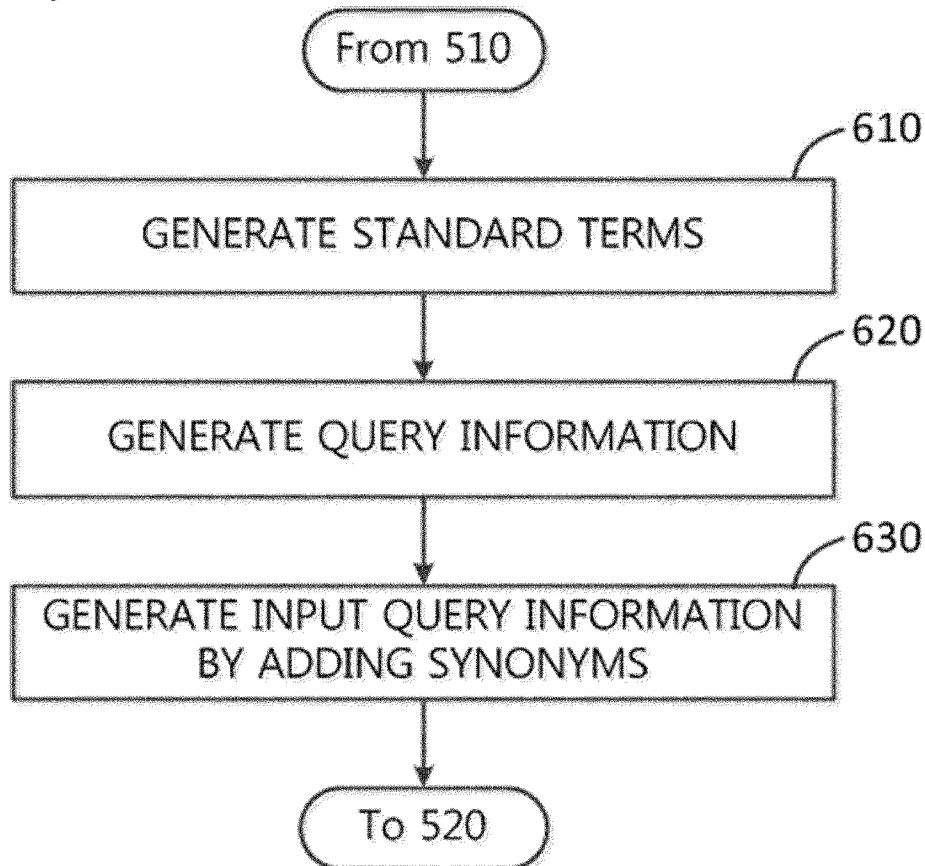
[Fig. 4]



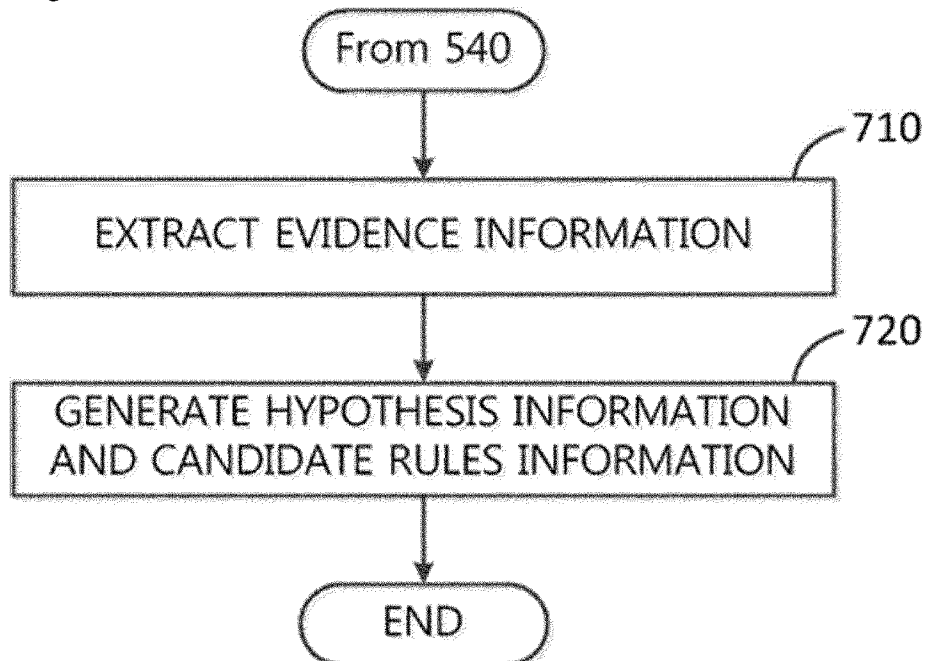
[Fig. 5]



[Fig. 6]



[Fig. 7]



INTERNATIONAL SEARCH REPORT

International application No.
PCT/KR2014/012298**A. CLASSIFICATION OF SUBJECT MATTER****G06Q 50/24(2012.01)i, G06Q 50/22(2012.01)i**

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)

G06Q 50/24; G06F 19/00; G06F 17/30; G06Q 50/22; G06Q 10/00

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

Korean utility models and applications for utility models

Japanese utility models and applications for utility models

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

eKOMPASS(KIPO internal) & Keywords: , ,

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 2014-0025701 A1 (ALIBABA GROUP HOLDING LIMITED) 23 January 2014 See paragraphs [0005]; [0017]; [0021]; [0044]; [0074]; claims.	1-14
Y	KR 10-2010-0097522 A (SEOUL NATIONAL UNIVERSITY) 03 September 2010 See paragraph [0028] and claims.	1-14
A	JP 2010-262504 A (NIPPON MICRO SYSTEMS KK) 18 November 2010 See abstract and claims.	1-14
A	US 2012-0117088 A1 (KAWAKAMI YOUICHI et al.) 10 May 2012 See abstract and claims	1-14



Further documents are listed in the continuation of Box C.



See patent family annex.

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"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

09 September 2015 (09.09.2015)

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Name and mailing address of the ISA/KR

International Application Division
Korean Intellectual Property Office
189 Cheongsu-ro, Seo-gu, Daejeon Metropolitan City, 35208,
Republic of Korea

Facsimile No. +82-42-472-7140

Authorized officer

PARK, Jeong Ung

Telephone No. +82-42-481-3355



INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

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