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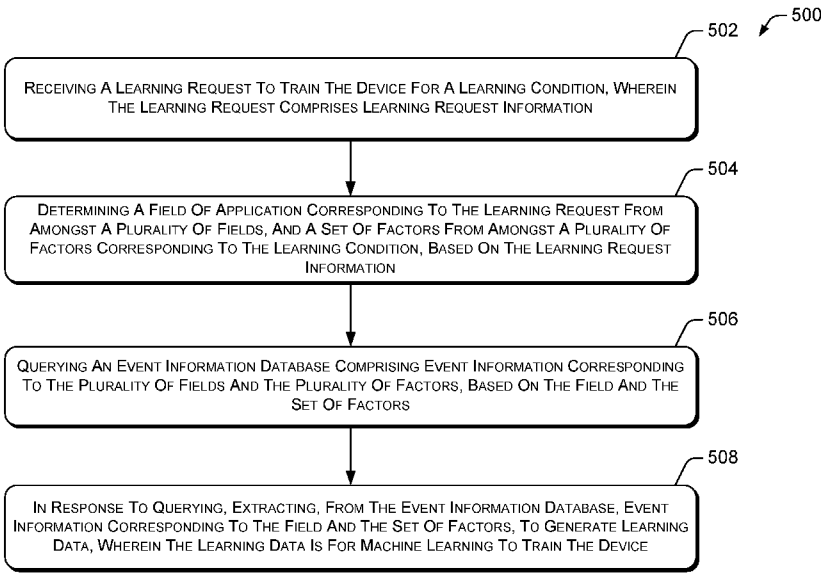


Fig. 5

(57) Abstract: Techniques for generation of learning data are described. In an example, a method for generating learning data includes receiving a learning request to train a user device for a learning condition, where the learning request comprises learning request information. The method also includes determining a field of application corresponding to the learning request, based on the learning request information. The method also includes querying an event information database based on the field and the set of factors, and in response to querying, extracting, from the event information database, event information corresponding to the field and the set of factors, to generate learning data, wherein the learning data is for machine learning to train the user device.

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Description

Title of Invention: GENERATING LEARNING DATA

FIELD OF INVENTION

[0001] The present subject matter relates to machine learning and, particularly, but not exclusively, to generation of learning data for machine learning.

Background

[0002] Machine learning is a form of artificial intelligence that is employed to allow computing devices to evolve behaviors based on event information data. Event information data may include various examples and sample data related to different events and their attributes. Machine learning may take advantage of the event information data to capture characteristics of interest and determine probability distribution related to occurrence of various conditions.

Brief Description of Drawings

[0003] The detailed description is provided with reference to the accompanying figures. In the figures, the left-most digit(s) of a reference number identifies the figure in which the reference number first appears. The same numbers are used throughout the drawings to reference like features and components.

[0004] [fig.1]Fig. 1 illustrates an example computing environment, implementing a learning service device to generate learning data, according to an example implementation of the present subject matter;

[fig.2]Fig. 2 illustrates various elements of a learning service device, according to an example implementation of the present subject matter;

[fig.3]Fig. 3 illustrates various elements of a learning device, according to an example implementation of the present subject matter;

[fig.4]Fig. 4 illustrates various elements of a user device, according to an example implementation of the present subject matter;

[fig.5]Fig. 5 illustrates a flowchart representative of a method of generating learning data, according to an example implementation of the present subject matter; and

[fig.6]Fig. 6 illustrates an example computing environment, implementing a non-transitory computer-readable medium for generating learning data for machine learning in the computing environment.

DETAILED DESCRIPTION

[0005] The present subject matter relates to techniques of generating learning data for machine learning. The techniques described herein can be implemented in a variety of learning devices which are capable of performing machine learning based on learning data, including but not limited to, page ranking servers, factory automation devices,

automated translation systems, and the like. Further, the learning data may be generated for different fields of application, for example, but not limited to, healthcare, factory automation, insurance, fraud analysis, automated navigation, access control, facial recognition, speech analysis and automated voice generation.

[0006] Generally, to perform machine learning, event information data is utilized by learning devices. Learning devices may identify characteristics of interest from the event information data to determine patterns and may identify behaviors for machine learning. The event information data is a collection of information relating to different events occurring in different fields of application. For example, the event information data may include information corresponding to a field of life insurance and events occurring in this field, such as change in blood pressure, increase in heart rate, increase in height, gain of weight, increase in cholesterol level, etc., of different users. Similarly, the event information data may also include information corresponding to others fields of application, such as information corresponding to the field of farming and events occurring in such field, such as size of various types of crops, weight of the crops, growth exhibited by the crops in a given duration of time, seasonal factors affecting the growth of the crops and color of crops. Therefore, the event information data may include information relating to different fields and events occurring in such different fields.

[0007] Since the fields for which the machine learning can be performed are widespread, the event information data includes enormous records and data corresponding to various fields, and events occurring in such fields. While learning devices utilize the event information data for machine learning, processing the entire event information data for machine learning is time consuming and causes long delays. Further, to perform machine learning in a particular field of application, processing of the entire event information data leads to wastage of resources, thereby making the process cumbersome and inefficient.

[0008] According to an example implementation of the present subject matter, techniques of generating learning data for machine learning are described. The described techniques allow for generation of learning data which provide a set of relevant event information data to learning devices for the purpose of machine learning. Therefore, the implementation of the described techniques enables efficient processing of the event information data and provides for effective machine learning resulting is minimizing the consumption of computing resources and faster turn-around-time required to train user devices.

[0009] In an example implementation of the present subject matter, learning data may be generated for machine learning corresponding to a learning condition. The machine learning thus performed, may be used for training a user device corresponding to the

learning condition. In an example, the learning condition may be indicative of a predetermined condition for which the machine learning is to be performed and the user device is to be trained. The learning data generated for such a learning condition may be suggestive of a reduced event information data, which corresponds to the learning condition. In other words, to train a user device corresponding to a given learning condition, a part of the event information data that is relevant to the given learning condition, may alone be considered.

[0010] In operation, a learning request to train a user device for a learning condition may be received. The learning request may include a learning request information to indicate that machine learning is to be performed for a learning condition. For example, the learning condition may be defined as 'prediction of failure of a motor for a conveyor in a line equipment', and for such a learning condition, machine learning may have to be performed to train a failure prediction device for predicting failure of the motor.

[0011] Further, based on the learning condition and the learning request information, a field of application corresponding to the learning condition may be determined. That is, if the learning request is for the above described learning condition of predicting failure of a motor for a conveyor in a line equipment, the field corresponding to the learning condition may be determined to be 'factory automation'.

[0012] Furthermore, based on the learning request information and the learning condition, a set of factors may also be determined that may contribute to machine learning for the learning condition. For example, in the above described situation, corresponding to the field of factory automation, a set of factors, such as weight on a conveyor and load on a motor may be determined to contribute to the machine learning for the learning condition of predicting failure of the motor for the conveyor in a line equipment.

[0013] Upon determination of the field of application and the set of factors corresponding to the learning condition, an event information database may be queried to determine event information corresponding to the determined field and the determined set of factors. In an example, the event information database may include event information data, which has collection of information relating to different events occurring in different fields of application, and the query of the event information database may generate the event information corresponding to the determined field of application and the set of factors. In other words, the event information can be understood as a sub-set of information, retrieved from the event information database, which would allow machine learning for the learning condition.

[0014] In an example implementation of the present subject matter, the event information may be utilized to generate learning data, and the learning data may further be utilized by learning devices for the purpose of machine learning corresponding to the learning condition. Thus, the implementation of the described techniques allow generation of

the learning data based on a definite field and a set of factors. Such learning data relating to the definite field is a reduced part of the event information data comprising events relating to numerous fields, and is utilized for performing machine learning for the learning condition. The utilization of the generated learning data by learning devices allows for reduced processing and thereby provides efficient machine learning.

[0015] The above techniques are further described with reference to Fig. 1 to Fig. 6. It should be noted that the description and the figures merely illustrate the principles of the present subject matter along with examples described herein and, should not be construed as a limitation to the present subject matter. It is thus understood that various arrangements may be devised that, although not explicitly described or shown herein, embody the principles of the present subject matter. Moreover, all statements herein reciting principles, aspects, and implementations of the present subject matter, as well as specific examples thereof, are intended to encompass equivalents thereof.

[0016] Fig. 1 schematically illustrates a computing environment 100, implementing a learning service device 102 to generate learning data, according to an example implementation of the present subject matter. The computing environment 100 may either be a public distributed environment, or may be a private distributed environment. In an example, the learning service device 102 is communicatively coupled to a learning request device 104 and a learning device 106, through a communication network 108. The learning request device 104 may provide different learning requests to the learning service device 102 for the purpose of performing machine learning corresponding to different learning conditions. The learning service device 102, based on the learning requests, may generate learning data and provide the generated learning data to the learning device 106. Further, the learning device 106 may perform machine learning based on the learning data generated by the learning service device 102.

[0017] According to an example implementation of the present subject matter, the learning service device 102 may generate learning data corresponding to a learning condition, based on a learning request received from the learning request device 104. Accordingly, the learning service device 102 may be implemented as, but is not limited to, a server, a workstation, a desktop computer, a laptop, a mainframe, a virtual host, an application, and the like. Further, the learning service device 102 may also be a machine readable instructions-based implementation or a hardware-based implementation or a combination thereof.

[0018] Further, the learning request device 104 may be implemented as, but is not limited to, a server, a workstation, a desktop computer, a laptop, a smart phone, a personal digital assistant (PDAs), a tablet, a virtual host, an application, and the like. According to the example implementations of the present subject matter, the learning request device 104 may be implemented in different fields of application from where learning requests for

different learning conditions may be generated. For example, the learning request device 104 may be implemented in a hospital to generate learning requests in the field of healthcare, corresponding to different learning conditions of healthcare. Similarly, the learning request device 104 may also be implemented in an automated factory to generate learning requests in the field of factory automation, corresponding to different learning conditions of factory automation.

[0019] In an example implementation of the present subject matter, the learning device 106 may utilize the learning data generated by the learning service device 102 for the purpose of machine learning. Accordingly, the learning device 106 may be implemented as, but is not limited to, a computational server, a learning server, a neural network, a mainframe, and the like. It would also be noted that the learning device 106 may be implemented as a combination of one or more computational engines to perform machine learning based on neural networks.

[0020] In an example implementation of the present subject matter, the learning service device 102 is further communicatively coupled to an event information database 110 through the communication network 108. The event information database 110 may include information relating to different events occurring in different fields of application. The event information database 110 may include empirical data of events occurring within different fields. For example, the event information database 110 may include information for events occurring in fields of healthcare, factory automation, speech recognition, access control, language translation, etc. The events, such as value of blood pressure, change in heart rate, increase in sugar level and, various activities performed by a person may also be monitored, such as a gaming activity or bathing, and may be recorded for the field of healthcare.

[0021] Similarly, the event information database 110 may also include information on multiple events occurring in the field of factory automation, such as load on a motor, current provided to a conveyer associated with the motor, voltage supplied to machinery parts associated with the motor, and weight of produced products by the machinery parts. Thus, it would be noted that the event information database 110 includes information corresponding to various fields and events occurring in each of such fields.

[0022] In an example implementation of the present subject matter, depending upon the use of the event information database 110 it may either be implemented as, but not limited to, a big data database, a document oriented database, a graph database, a relational database, a distributed database, a Hybrid Transactional/Analytical Processing (HTAP) database, a key-value database, and a correlational database.

[0023] Further, the event information database 110 may also be updated based on information gathered by multiple user devices 112-1, 112-2, 112-3, 112-4, ..., 112-N as

the multiple user devices 112-1, 112-2, 112-3, 112-4, ..., 112-N may be communicatively coupled to the event information database 110 through the communication network 108. For the sake of explanation, the user devices 112-1, 112-2, 112-3, 112-4, ..., 112-N have been commonly referred to as the user devices 112. In an example, the user devices 112 may be implemented in healthcare field where information related to patients is monitored and shared with the event information database 110. In the healthcare filed, the user devices 112 may be implemented as, but not limited to, vital statistics monitors to collect data for different attributes for patients. Such vital statistics monitoring devices may include different devices, such as heart rate monitors, blood pressure monitors, and blood sugar monitor. The vital statistics monitoring devices, upon determination of information for different patients, may share such information with the event information database 110. In certain situations, the user devices 112 may also be implemented as wearable devices and any vital information captured by such wearable devices may be stored and shared with the event information database 110. In an example, the user devices 112 may include any communication device to receive manual inputs from the user and communicate the same to the event information database 110. For example, a user may use the communication device to provide manual inputs relating to his time of bathing, inputs relating to discomfort being experience in any part of the body or inputs relating to an allergy, etc., for communicating the same to the event information database 110.

[0024] In another example, the user devices 112 may be implemented in field of factory automation. In such situations, the user devices 112 may be implemented as, but not limited to, load monitoring system, current monitoring devices, or different sensors for collecting and gathering data related for factory automation. In such implementation, the data gathered by the user devices 112 may be captured and shared with the event information database 110.

[0025] Therefore, it would be noted that the event information database 110 may include information related to different fields, where data corresponding to various events and attributes of each filed is stored within the event information database 110. Further, the event information database 110 may include empirical data along with data gathered from various sensors and computing devices, such as the user devices 112.

[0026] In an example implementation of the present subject matter, the user devices 112 may also be communicatively coupled to the learning request device 104, though a sub-network 114. The user devices 112 may also communicate with one another through the sub-network 114. Further, the user devices 112 may also communicate with the event information database 110 and the learning service device 102 through the communication network 108.

[0027] Any communication link, as depicted between the learning request device 104,

learning device 102, the event information database 110, the user devices 112, the learning service device 102 and the communication network 108 and the sub-network 114, may be enabled through a desired form of communication, for example, via dial-up modem connections, cable links, digital subscriber lines (DSL), wireless or satellite links, or any other suitable form of communication.

[0028] Further, the sub-network 114 and the communication network 108 may be a wireless network, a wired network, or a combination thereof. The sub-network 114 and the communication network 108 may also be an individual network or a collection of many such individual networks, interconnected with each other and functioning as a single large network, e.g., the Internet or an intranet. The sub-network 114 and the communication network 108 may be implemented as one of the different types of networks, such as intranet, local area network (LAN), wide area network (WAN), and such. Further, the sub-network 114 and the communication network 108 may either be a dedicated network or a shared network, which represents an association of the different types of networks that use a variety of protocols, for example, Hypertext Transfer Protocol (HTTP), Transmission Control Protocol/Internet Protocol (TCP/IP), etc., to communicate with each other.

[0029] The sub-network 114 and the communication network 108 may also include individual networks, such as, but are not limited to, Global System for Communication (GSM) network, Universal Telecommunications System (UMTS) network, Long Term Evolution (LTE) network, Personal Communications Service (PCS) network, Time Division Multiple Access (TDMA) network, Code Division Multiple Access (CDMA) network, Next Generation Network (NGN), Public Switched Telephone Network (PSTN), and Integrated Services Digital Network (ISDN). Depending on the implementation, the sub-network 114 and the communication network 108 may include various network entities, such as base stations, gateways and routers; however, such details have been omitted to maintain the brevity of the description. Further, it may be understood that the communication between different entities, such as the learning service device 102, learning request device 104, learning device 106, the event information database 110, and the user devices 112, and any other entities of the communication environment may take place based on the communication protocol compatible with the sub-network 114 or the communication network 108, as the case may be.

[0030] In operation, the learning request device 104 may generate a learning request to train the user devices 112 corresponding to a learning condition. The learning service device 102 may receive such learning request and may generate learning data for machine learning. The learning service device 102 may utilize the event information database 110 for the purpose of generation of the learning data. For the ease of understanding, the functioning of the learning service device 102, and manner in which the learning

data is generated, has been described in reference to the forthcoming description of Fig. 2, Fig. 3 and Fig. 4.

[0031] Fig. 2 schematically illustrates components of the learning service device 102, according to an example implementation of the present subject matter. The learning service device 102 may include processor(s) 202 and interface(s) 204.

[0032] The processor(s) 202 may be implemented as microprocessor(s), microcomputer(s), microcontroller(s), digital signal processor(s), central processing unit(s), state machine(s), logic circuit(s), and/or any device(s) that manipulates signals based on operational instructions. Among other capabilities, the processor(s) 202 may fetch and execute computer-readable instructions stored in a memory. The functions of the various elements shown in the figure, including any functional blocks labeled as "processor(s)", may be provided through the use of dedicated hardware as well as hardware capable of executing machine readable instructions.

[0033] The interface(s) 204 may include a variety of machine readable instructions-based interfaces and hardware interfaces that allow the learning service device 102 to interact with different other resources of the learning service device 102. Further, the interface(s) 204 may enable the learning service device 102 to communicate with other communication and computing devices, such as network entities, web servers, and external repositories.

[0034] Further, the learning service device 102 may include a memory 206, communicatively coupled to the processor(s) 202. The memory 206 may include any computer-readable medium including, for example, volatile memory (e.g., RAM), and/or non-volatile memory (e.g., EPROM, flash memory, Memristor, etc.).

[0035] Further, the learning service device 102 may include engine(s) 208 and data 210. The engine(s) 208 may be communicatively coupled to the processor(s) 202. The engine(s) 208, amongst other things, include hardware units made of combination of electrical circuits and electronic components along with embedded or programmable routines, objects, components, data structures, and the like, to perform particular tasks or implement particular abstract data types. The engine(s) 208 further include hardware that supplement applications on the learning service device 102.

[0036] The data 210 serves, amongst other things, as a repository for storing data that may be fetched, processed, received, or generated by the engine(s) 208. Although the data 210 is shown internal to the learning service device 102, it may be understood that the data 210 may reside in an external repository, such as the event information database 110, which may be communicatively coupled to the learning service device 102. The learning service device 102 may communicate with the external repository through the interface(s) 204 to obtain information from the data 210.

[0037] In an implementation, the engine(s) 208 of the learning service device 102 may

include a communication engine 212, a processing engine 214, and a data generation engine 216. The learning service device 102 may also include other engines to perform other incidental tasks of the learning service device 102.

[0038] In an example implementation of the present subject matter, the data 210 of the learning service device 102 may include learning data 218, event information data 220, and other data 222. The other module(s) 216 may include programs or coded instructions that supplement applications and functions, for example, programs in the operating system of the learning service device 102, and the other data 222 fetched, processed, received, or generated by the other module(s) 216.

[0039] The following description explains how the learning service device 102 and its various components, generate the learning data for performing machine learning to train any user device 112, according to an example implementation of the present subject matter.

[0040] In an example implementation of the present subject matter, the communication engine 212 of the learning service device 102 may receive a learning request from the learning request device 104. The learning request may request to train one of the user devices 112 for a learning condition. For example, the learning request may be sent by the learning request device 104 to train the user device 112-2 for estimating good awakening of a person on next day. In other words, the learning request is to train the user device 112-2 to be able to estimate occurrence of a defined learning condition of good awakening of a person on the next day.

[0041] In an implementation, the learning request may include a learning request information which is indicative of different aspects of the learning request, such as the learning condition, the user device for which the training is to be performed, the day for which the learning condition is to be determined, etc. As described earlier, the learning service device 102 may be communicatively coupled with the learning request device 104 through the communication network 108. Therefore, the learning request may be received in any protocol supported by the communication network 108. In an example implementation of the present subject matter, the learning request information may also include other incidental information, such as unique identification of the learning request device 104, and learning request id.

[0042] In an implementation, the processing engine 214 of the learning service device 102 may determine field of application corresponding to the learning condition received in the learning request. That is, the processing engine 214 may determine the field of application for which the machine learning is to be performed and the user device 112-2 that is to be trained. For example, if the above learning request for estimating good awakening of a person is received, the processing engine 214 may determine the field of application to be healthcare. In another example, if the learning request is to detect

failure of a machine conveyer belt, the processing engine 214 may determine the field of application to be factory automation.

[0043] Upon determining the field, the processing engine 214 may also determine a set of factors which contribute to the fulfillment of the learning condition. For example, corresponding to the learning request for estimating good awakening of a person, the processing engine 214 may determine a set of factors which contribute in bringing a state of good awakening. For example, the processing engine 214 may determine two factors A and B which bring about the state of good awakening. The two factors may be identified to be as:

A → The blood pressure of the person is to be within a range of 115 to 60 millimeters of mercury (mmHg) during 7:00 to 9:00 hours, and the calorie intake is to be within a range of 500 to 600 calories; and

B → The blood pressure of the person is to be within a range of 120 to 65 mmHg during 18:00 to 21:00 hours, and the calorie intake is to be within a range of 1000 to 800 calories.

[0044] In an example implementation of the present subject matter, the field of application and the set of factors that correspond to the learning condition, may be included in the learning request information received by the learning service device 102. That is, the learning request information included in the learning request may indicate the field of application along with the set of factors which contribute to the occurrence of the learning condition. For example, the learning request for estimating good awakening of a person may include the field information of 'healthcare' in the learning request information along with the above described two factors A and B, which bring about the state of good awakening. In another example, the processing engine 214 may automatically determine the field of application and the set of factors, based on the learning condition received in the learning request.

[0045] In an example implementation of the present subject matter, upon determination of the field of application and the set of factors that contribute to the fulfillment of the learning condition, the learning service device 102 may generate learning data. To generate the learning data, the data generation engine 216 of the learning service device 102 may query the event information database 110. In an example, the data generation engine 216 may query the event information database 110 based on the determined field and the set of factors. As described earlier, the event information database 110 may include information corresponding to events occurring in different fields of application.

[0046] In an example implementation, the event information database 110 may be a relational database, including records for different events of different fields. For example, the event information database 110 may include information stored in the

following format:

[Table 1]

EVENTS ↓	EVENT INFORMATION						
	EVENT ID	EVENT START DATE AND TIME	EVENT FINISH DATE AND TIME	EVENT DETAIL 1	EVENT DETAIL 2	EVENT DETAILS 3	REMARK
Event 1	XXXXX XXXXX	YYYY/MM/DD HH:SS	YYYY/MM/DD HH:SS	Maximum Value	Minimum Value	None	None
Event 2	XXXXX XXXXX	YYYY/MM/DD HH:SS	YYYY/MM/DD HH:SS	Absolute Value	None	None	None
Event 3	XXXXX XXXXX	YYYY/MM/DD HH:SS	YYYY/MM/DD HH:SS	Maximum Value	Minimum Value	None	None
Event 4	XXXXX XXXXX	YYYY/MM/DD HH:SS	YYYY/MM/DD HH:SS	Absolute Value	None	None	None
Event 5	XXXXX XXXXX	YYYY/MM/DD HH:SS	YYYY/MM/DD HH:SS	Maximum Value	Minimum Value	None	None
Event 6	XXXXX XXXXX	YYYY/MM/DD HH:SS	YYYY/MM/DD HH:SS	Absolute Value	None	None	None

[0047] Table 1 represents an exemplary format in which information may be stored in the event information database 110. As depicted in the table, each row may correspond to an event for which information is stored in the event information database 110. Further, corresponding to each event, different information may be stored in the respective columns. For example, for each event a corresponding event Id may be stored. Event id may be understood as a unique id corresponding to each event. In an example implementation of the present subject matter, the event id may be stored in a 10-digit format, such that the first 4 digits of the event id are indicative of a field of application of the event. For example, 4 digits 1001 may represent field of healthcare and digits 1002 may represent field of factory automation. Further, next 2 digits may indicate a classification of the event. Furthermore, the last 4 digits of the event id may correspond to the event itself.

[0048] To further explain the format in which data is stored in the event information database 110, a sample of records including different events, for various fields have been described in Table 2.

[Table 2]

EVENTS ↓	EVENT INFORMATION						
	EVENT ID	EVENT START DATE AND TIME	EVENT FINISH DATE AND TIME	EVENT DETAIL 1	EVENT DETAIL 2	EVENT DETAILS 3	REMARK
...	...	...	...	...	...	...	...
Waking Up	1001000001	2016/01/01 07:00	2016/01/01 07:00	None	None	None	None
Motor Load	1002110001	2016/01/01 14:10	2016/01/01 14:11	Measured – 2 KW	None	None	None
Blood Pressure	1001000002	2016/01/01 07:15	2016/01/01 07:16	Maximum Value - 115	Minimum Value – 70	None	None
Motor Current	1002110003	2016/01/01 14:02	2016/01/01 14:03	Maximum Value – 12 Amp	Minimum Value – 10 Amp	None	None
Heart Beat	1001000005	2016/01/01 07:10	2016/01/01 07:10	Heart Rate - 60	None	None	None
Taking Bath	1001120283	2016/01/01 08:30	2016/01/01 08:40	Temperature of Bath - 38	None	None	None
Crop Weight	1004550153	2016/01/01 09:00	2016/01/01 09:00	Measured Value – 1Kg	None	None	None
Meal	1001000005	2016/01/01 07:55	2016/01/01 08:17	Intake Calorie - 700	Number of times of Chewing - 150	None	None
Motor Voltage	1002000253	2016/01/01 14:30	2016/01/01 14:35	Maximum Value – 245 Volts	Minimum Value – 228 Volts	None	None
Gaming	1001000006	2016/01/01 09:10	2016/01/01 09:55	Kind of Game - 41	None	None	None
Crop Size	1004540154	2016/01/01 09:00	2016/01/01 09:00	Length – 20 cm	None	None	None
...	...	...	...	...	...	...	...

[0049] It would be noted that the events corresponding to different fields include different first 4 digits of the event Id. For example, events corresponding to the healthcare field include '1001' as the first 4 digits of the event id. Similarly, events corresponding to the 'factory automation' field include '1002' as the first 4 digits of the event id, and events corresponding to the 'farming' field include '1004' as the first 4 digits of the event id. Accordingly, it would be appreciated that the event information database 110 may include information for different events occurring in various fields of application, in the above described format.

[0050] Further, it would be noted that the events of each field may either correspond to an

activity performed, such as taking bath and gaming, or may also correspond to timely recording of certain vital information, such as recording of blood pressure, or determination of crop size.

[0051] In an example implementation of the present subject matter, based on the query of the data generation engine 216, the information within the event information database 110 may first be limited based on the queried field, and may then be further limited based on the set of factors, to extract the event information. For example, for the learning request for estimating good awakening of a person on next day, where the determined field of learning request is 'healthcare', the data generation engine 216 may first limit the information within the event information database 110 based on event Id '1001'. An example of the limited information identified by the data generation engine 216 for the field of 'healthcare' is depicted in Table 3.

[Table 3]

EVENTS	EVENT INFORMATION						
	EVENT ID	EVENT START DATE AND TIME	EVENT FINISH DATE AND TIME	EVENT DETAIL 1	EVENT DETAIL 2	EVENT DETAIL 3	REMARK
...	...	...	...	...	...	...	...
Waking Up	1001000001	2016/01/01 07:00	2016/01/01 07:00	None	None	None	None
Blood Pressure	1001000002	2016/01/01 07:15	2016/01/01 07:16	115	70	None	None
Heart Beat	1001000005	2016/01/01 07:10	2016/01/01 07:10	60	None	None	None
Meal	1001000005	2016/01/01 07:55	2016/01/01 08:17	550	150	None	None
...	...	YYYY/MM/DD HH:SS	YYYY/MM/DD HH:SS	None	None	None	None
Gaming	1001000006	2016/01/01 09:10	2016/01/01 09:55	Kind of Game - 41	None	None	None
Taking Bath	1001120283	2016/01/01 08:30	2016/01/01 08:40	Temperature of Bath - 38	None	None	None
Blood Pressure	1001000002	2016/01/01 20:30	2016/01/01 20:31	Maximum Value - 120	Minimum Value – 75	None	None
Heart Beat	1001000005	2016/01/01 21:00	2016/01/01 21:01	Heart Rate - 55	None	None	None
Meal	1001000005	2016/01/01 22:00	2016/01/01 22:15	Intake Calorie - 600	Number of times of Chewing - 180	None	None
...	...	...	...	...	...	...	...

[0052] It would be noted that Table 3 depicts information limited by the data generation engine 216 based on the field 'healthcare'. Further, different events, such waking up of a person, his meals details, and other activities performed by the person, such as gaming have been included in the events along with timely recording of certain vital information, such as recording of blood pressure and heart rate.

[0053] Upon extraction of the event information, as depicted above in table 3, the event information which satisfies the set of factors determined by the processing engine 214, may be determined. As described earlier, the processing engine 214 may determine the following two factors A and B corresponding to the learning request for estimating good awakening of a person on next day; and the data generation engine 216 may limit the event information of table 3 based on such determined factors:

A → The blood pressure of the person is to be within a range of 115 to 60 millimeters of mercury (mmHg) during 7:00 to 9:00 hours, and the calorie intake is to be within a range of 500 to 600 calories; and

B → The blood pressure of the person is to be within a range of 120 to 65 mmHg during 18:00 to 21:00 hours, and the calorie intake is to be within a range of 1000 to 800 calories.

[0054] The event information thus extracted by the data generation engine 216 may correspond to the information which may be utilized for the purpose of generation of learning data. In an example implementation of the present subject matter, the data generation engine 216 may generate learning data from the extracted event information. Further, the learning data may be utilized for the purpose of machine learning which may be used to train the user devices 112 for the learning condition.

[0055] It would be appreciated that while the extraction of event information has been described with the help of the learning request for estimating good awakening of a person on next day in the healthcare field, the described techniques may be applied for other learning requests of different fields as well.

[0056] In an example implementation of the present subject matter, the learning data generated by the data generation engine 216 is provided to the learning device 106 by the communication engine 212, for the purpose of machine learning. The manner in which the learning device 106 may utilize the learning data for machine learning has been further described in reference to Fig. 3.

[0057] Fig. 3 illustrates various elements of the learning device 106, according to an example implementation of the present subject matter. In an example implementation, the learning device 106 may include a learning device communication engine 302 to communicate with the communication network 108. The learning device communication engine 302 may receive and send data with other entities of the communication environment 100, such as the learning service device 102, the learning request

device 104, and the user devices 112. In an example implementation of the present subject matter, the learning device communication engine 302 may receive learning data generated by the data generation engine 216 of the learning service device 102.

[0058] As described earlier, the learning data generated by the data generation engine 216 of the learning service device 102 may include a set of relevant data extracted from the event information database 110, based on a field and set off factors determined corresponding to a learning request and associated learning condition. The learning data received by the learning device communication engine 302 may be provided to a learning control engine 304 and a neural network 306 of the learning device 106, for the purpose of machine learning. The neural network 306 may utilize the learning data to perform the machine learning.

[0059] In an example implementation of the present subject matter, the result of the machine learning performed by the neural network 306 may be extracted by a learning result extraction engine of the learning device 106. The output of the machine learning may be provided to the learning device communication engine 302 by a learning result output engine 310 of the learning device 106.

[0060] Therefore, the learning device 106 may receive the learning data from the learning service device 102, perform machine learning through the neural network 306, and may provide the result of the machine learning back to the learning service device 102, through the learning device communication engine 302.

[0061] In an example implementation of the present subject matter, the result of the machine learning is received by the communication engine 212 of the learning service device 102. The communication engine 212 of the learning service device 102 may further provide the result of the machine learning to the learning request device 104. The result of the machine learning may finally be provided to the user devices 112 to train them for occurrence of the learning condition.

[0062] Fig. 4 illustrates various elements of a user device, according to an example implementation of the present subject matter. In an example implementation, the user device may include a user device communication engine 402 to communicate with the communication network 108 and the sub-network 114. Through the user device communication engine 402, the user device may send data which has been gathered by various data acquisition engines 404. As described earlier, the user devices 112 may gather data corresponding to various events. Accordingly, the user device may include multiple data acquisition engines 404 to gather such data. For example, the data acquisition engines may include different sensors to monitor vitals of patients in a hospital. Data gathered by such sensors (data acquisition engines 404) may be provided to the event information database 110 for updating the information from time to time.

[0063] Further, through the user device communication engine 402, the user device may also receive information from other entities of the communication environment 100. For example, the result of the machine learning may be received by the user device communication engine 402 from the learning request device 104, through the sub-network 114. The result of the machine learning may be utilized by a learning result input engine 406. The learning result input engine 406 may provide the result of the machine learning to a neural network settings engine 408 for setting a neural network 410 of the user device. The neural network 410, when configured by the neural network settings engine 408, may be trained for the learning condition for which the result of machine learning has been received by the user device communication engine 402.

[0064] In an example implementation of the present subject matter, any result derived by the user device upon being trained for the learning condition, may be provided to the users through a data providing engine 412.

[0065] Fig. 5 illustrates a method 500 for generating learning data, according to an implementation of the present subject matter. The order in which the method 500 is described is not intended to be construed as a limitation, and any number of the described method blocks may be combined in any order to implement the method 500, or an alternative method. Furthermore, the method 500 may be implemented by processor(s) or computing device(s) through any suitable hardware, non-transitory machine readable instructions, or combination thereof.

[0066] It may be understood that steps of the method 500 may be performed by programmed computing devices. The steps of the methods 400 and 500 may be executed based on instructions stored in a non-transitory computer readable medium, as will be readily understood. The non-transitory computer readable medium may include, for example, digital memories, magnetic storage media, such as one or more magnetic disks and magnetic tapes, hard drives, or optically readable digital data storage media.

[0067] Further, although the methods 400 and 500 may be implemented in a variety of computing resource of federated computing environment; in an example implementation of Fig. 5, the methods 500 may be explained in context of aforementioned learning service device 102 of the computing environment 100, for ease of explanation.

[0068] Referring to Fig. 5, in an example implementation of the present subject matter, at block 502, a learning request to train the device for a learning condition is received. In an example, the learning request may include a learning request information. In an example, the learning request device 104 may generate the learning request and the learning service device 102 may receive such learning request through a communication network 108.

[0069] In an example, the learning request information may include information corresponding to the learning condition along with other incidental information like device

id of the learning request device 104, etc. It would be noted that the learning request may relate to any field of application, depending on the learning condition for which user device is to be trained.

[0070] For instance, the learning request related to a field of factory automation may be for training a user device to "estimate failure of a motor for a conveyor in a production line equipment". Therefore, the learning condition for which the user device is to be trained for such received learning request can be identified to be as "failure of a motor for a conveyor in a production line equipment". Similarly, another learning request related to the field of farming may be for training the user device to "estimate harvest time of a crop". Therefore, it would be noted that different learning requests may relate to different fields of application and may be for different learning conditions.

[0071] At block 504, a field of application corresponding to the learning request may be determined, from amongst a plurality of fields. Further, a set of factors from amongst a plurality of factors corresponding to the learning condition may also be determined, based on the learning request information. In an example, if the learning request relates to estimating failure of a motor for a conveyor in a production line equipment, the field of application may be determined to be as factory automation. The determination of the field of application may either be done based on information stored in the learning request information, or may be automatically done by the learning service device 102 based on the learning condition of the learning request.

[0072] In an example implementation of the present subject matter, if the learning request is to train a user device for estimating failure of a motor for a conveyor in a production line equipment, the set of factors that may be determined to contribute to the fulfillment of the learning condition may include:

A → The maximum weight of work to be conveyed after a predetermined time from the start of the operation of the conveyor is within a range of 105 to 115 kg, and detection time of a photoelectric sensor for detecting a conveying work is within a range of 300 to 450 milli-seconds (ms); and

B → The maximum value of a weight of the work to be conveyed at a point of time after a predetermined time before from the finish of the operation of the conveyor is within a range of 105 to 115 kg, and detection time of the photoelectric sensor for detecting the conveying work is within a range of 500 to 650 ms.

[0073] Similarly, if the learning request is to train a user device for a learning condition related to field of farming, the set of factors may accordingly be determined. The set of factors may either be included in the learning request information, or may also be determined by the learning service device 102, depending upon the implementation. If the determination of the set of factors is performed by the learning service device 102, it may be based on the learning condition of the learning request.

[0074] At block 506, an event information database comprising event information corresponding to the plurality of fields and the plurality of factors may be queried, based on the field and the set of factors. In an example implementation of the present subject matter, the event information database is the event information database 110, as explained above in Fig. 1. The event information database 110 may include information corresponding to various events occurring in various fields.

[0075] In an example, the event information database 110 may include information in the format as depicted below in Table 4. It would be appreciated that table 4 includes sample data corresponding to certain sample events of different fields, however, the actual data included in the event information database 110 may include more entries corresponding to different events occurring in different fields.

[Table 4]

EVENTS ↓	EVENT INFORMATION						
	EVENT ID	EVENT START DATE AND TIME	EVENT FINISH DATE AND TIME	EVENT DETAIL 1	EVENT DETAIL 2	EVENT DETAIL 3	REMARK
...	...	...	...	...	...	...	...
Waking Up	1001000001	2016/01/01 07:00	2016/01/01 07:00	None	None	None	None
Watering	1004260004	2016/01/01 08:00	2016/01/01 08:17	Quantity – 200 Ltr	None	None	None
Motor Load	1002110001	2016/01/01 14:10	2016/01/01 14:11	Measured – 2 KW	None	None	None
Blood Pressure	1001000002	2016/01/01 07:15	2016/01/01 07:16	Maximum Value - 115	Minimum Value – 70	None	None
Pesticide	1004056523	2016/01/01 09:00	2016/01/01 09:05	Type - 23	None	None	None
Motor Current	1002110003	2016/01/01 14:02	2016/01/01 14:03	Maximum Value – 12 Amp	Minimum Value – 10 Amp	None	None
Heart Beat	1001000005	2016/01/01 07:10	2016/01/01 07:10	Heart Rate - 60	None	None	None
Taking Bath	1001120283	2016/01/01 08:30	2016/01/01 08:40	Temperature of Bath - 38	None	None	None
Crop Weight	1004550153	2016/01/01 09:00	2016/01/01 09:00	Measured Value – 1Kg	None	None	None
Meal	1001000005	2016/01/01 07:55	2016/01/01 08:17	Intake Calorie - 700	Number of times of Chewing - 150	None	None
Motor Voltage	1002000253	2016/01/01 14:30	2016/01/01 14:35	Maximum Value – 245 Volts	Minimum Value – 228 Volts	None	None
Gaming	1001000006	2016/01/01 09:10	2016/01/01 09:55	Kind of Game - 41	None	None	None
Crop Size	1004540154	2016/01/01 09:00	2016/01/01 09:00	Length – 20 cm	None	None	None
...	...	...	...	...	...	...	...

[0076] It would be noted that information for different events, such as taking bath by a patient, watering of crops, gaming activity by a patient, load handled by a motor, is stored in the event information database 110, which corresponds to various fields of application.

[0077] At block 508, event information corresponding to the field and the set of factors is extracted. In an example implementation of the present subject matter, the learning

service device 102 may limit the information of the event information database 110 by the determined field, and the set of factors. The limited information (event information) corresponding to the events of interest may be further utilized to generate learning data.

[0078] In an example implementation of the present subject matter, the learning data is utilized for machine learning to train the user device. For example, the learning data may be used by the learning device 106 to generate learning result. The learning result may be utilized by the user device to train for the learning condition.

[0079] Fig. 6 illustrates a computing environment 600 implementing a non-transitory computer-readable medium 602, according to an implementation of the present subject matter. In one implementation, the non-transitory computer readable medium 602 may be utilized for generating learning data. The learning service device 102 may be a part of the computing environment 600 and be implemented in a public networking environment or a private networking environment. In one implementation, the computing environment 600 includes a processing resource 604 communicatively coupled to the non-transitory computer readable medium 602 via a communication network 606, through a communication link 608.

[0080] For example, the processing resource 604 may be implemented in a computing resource, such as the learning service device 102 described earlier. The computer readable medium 602 may be, for example, an internal memory device or an external memory device. In one implementation, the communication link 608 may be a direct communication link, such as any memory read/write interface. In another implementation, the communication link 608 may be an indirect communication link, such as a network interface. In such a case, the processing resource 604 may access the computer readable medium 602 through the communication network 606. The communication network 606 may be a single network or a combination of multiple networks and may use a variety of different communication protocols.

[0081] The processing resource 604 and the computer readable medium 602 may also be communicating with an event information database 610 over the communication network 606. The event information database 610 may include event information occurring in various fields of application. The event information database 610 may be implemented as one of, but not limited to, a big data database, a document oriented database, a graph database, a relational database, a distributed database, a Hybrid Transactional/Analytical Processing (HTAP) database, a key-value database, and a correlational database.

[0082] In one implementation, the computer readable medium 602 includes a set of computer readable instructions, such as instructions 612, instructions 614, and instructions 616. The set of computer readable instructions may be accessed by the

processing resource 604 through the communication link 608 and subsequently executed to process data communicated with the users 610.

[0083] In an example implementation of the present subject matter, the instructions 612 of the computer readable medium 602 may receive a learning request to train a user device for a learning condition. In an example, the learning request may also include learning request information. Further, the instructions 614 of the computer readable medium 602 may determine a field of application and a set of factors corresponding to the learning condition received in the learning request.

[0084] In an example implementation of the present subject matter, the instructions 616 of the computer readable medium 602 may query the event information database 610 based on the determined field and the set of factors, to extract event information. The instructions 616 may also further generate learning data from the extracted event information.

[0085] Although implementations of communication in a federated computing environment have been described in language specific to structural features and/or methods, it is to be understood that the present subject matter is not necessarily limited to the specific features or methods described. Rather, the specific features and methods are disclosed and explained in the context of a few implementations for communication in federated computing environments.

Claims

[Claim 1] A method for generating learning data, the method comprising:
receiving a learning request to train a user device for a learning condition, wherein the learning request comprises learning request information;
determining a field of application corresponding to the learning request from amongst a plurality of fields, and a set of factors from amongst a plurality of factors corresponding to the learning condition, based on the learning request information;
querying an event information database comprising event information corresponding to the plurality of fields and the plurality of factors, based on the field and the set of factors; and
in response to querying, extracting, from the event information database, event information corresponding to the field and the set of factors, to generate learning data, wherein the learning data is for machine learning to train the user device.

[Claim 2] The method as claimed in claim 1, wherein the method further comprises providing the learning data to a learning device for machine learning.

[Claim 3] The method as claimed in claim 1, wherein the method further comprises receiving learning result from a learning device, and wherein the learning result facilitates training of the user device.

[Claim 4] The method as claimed in claim 1, wherein data within the event information database includes an event ID for values stored corresponding to each of the plurality of fields and each of the plurality of factors.

[Claim 5] The method as claimed in claim 1, wherein the field corresponding to the learning condition is one of healthcare, factory automation, aviation, insurance, security, and defense.

[Claim 6] The method as claimed in claim 1, wherein the user device provides assistance to users on occurrence of the learning condition, based on the training.

[Claim 7] A learning service device comprising:
a communication engine to receive a learning request to train a user device for a learning condition, wherein the learning request comprises learning request information;
a processing engine to determine a field of application corresponding to

the learning request from amongst a plurality of fields, and a set of factors from amongst a plurality of factors corresponding to the learning condition, based on the learning request information; and

a data generation engine to:

query an event information database comprising event information corresponding to the plurality of fields and the plurality of factors based on the field and the set of factors; and

in response to querying, extract, from the event information database, event information corresponding to the field and the set of factors, to generate learning data, wherein the learning data is for machine learning to train the user device.

[Claim 8] The learning service device as claimed in claim 7, wherein the communication engine is to further provide the learning data to a learning device for machine learning.

[Claim 9] The learning service device as claimed in claim 7, wherein the communication engine is to further receive learning result from a learning device, and wherein the learning result facilitates training of the user device.

[Claim 10] The learning service device as claimed in claim 9, wherein the communication engine is to further provide the learning result to a learning request device in response to the learning request, wherein the learning request device shares the learning result to the user device for training.

[Claim 11] A non-transitory computer-readable medium for generating learning data, the non-transitory computer readable medium comprising instructions executable by a processing resource to:

receive a learning request to train a user device for a learning condition, wherein the learning request comprises learning request information;

determine a field of application corresponding to the learning request from amongst a plurality of fields, and a set of factors from amongst a plurality of factors corresponding to the learning condition, based on the learning request information;

query an event information database comprising event information corresponding to the plurality of fields and the plurality of factors based on the field and the set of factors; and

in response to querying, extract, from the event information database, event information corresponding to corresponding to the field and the set of factors, to generate learning data, wherein the learning data is for machine learning to train the user device.

[Claim 12] The non-transitory computer-readable medium as claimed in claim 11, wherein the instructions are to further provide the learning data to a learning device for machine learning.

[Claim 13] The non-transitory computer-readable medium as claimed in claim 11, wherein data within the event information database includes a ten-bit event ID for values stored corresponding to each of the plurality of fields and each of the plurality of factors.

[Claim 14] The non-transitory computer-readable medium as claimed in claim 11, wherein the instructions are to further receive learning result from the learning device, and wherein the learning result facilitates training of the user device.

[Claim 15] The non-transitory computer-readable medium as claimed in claim 11, wherein the instructions are to further provide the learning result to a learning request device in response to the learning request.

[Fig. 1]

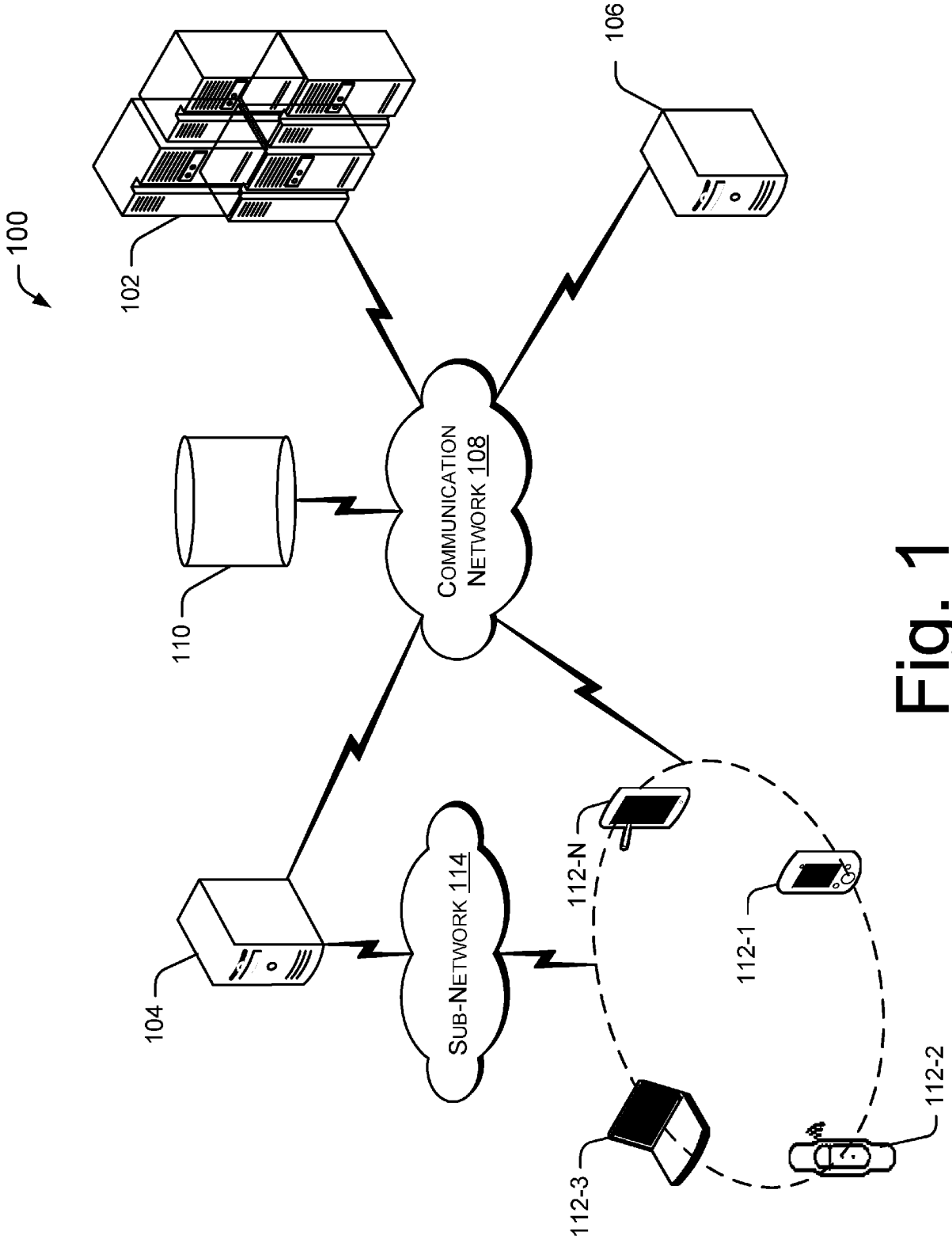

100
102
106
COMMUNICATION NETWORK 108
110
104
SUB-NETWORK 114
112-N
112-1
112-2
112-3

Fig. 1

[Fig. 2]

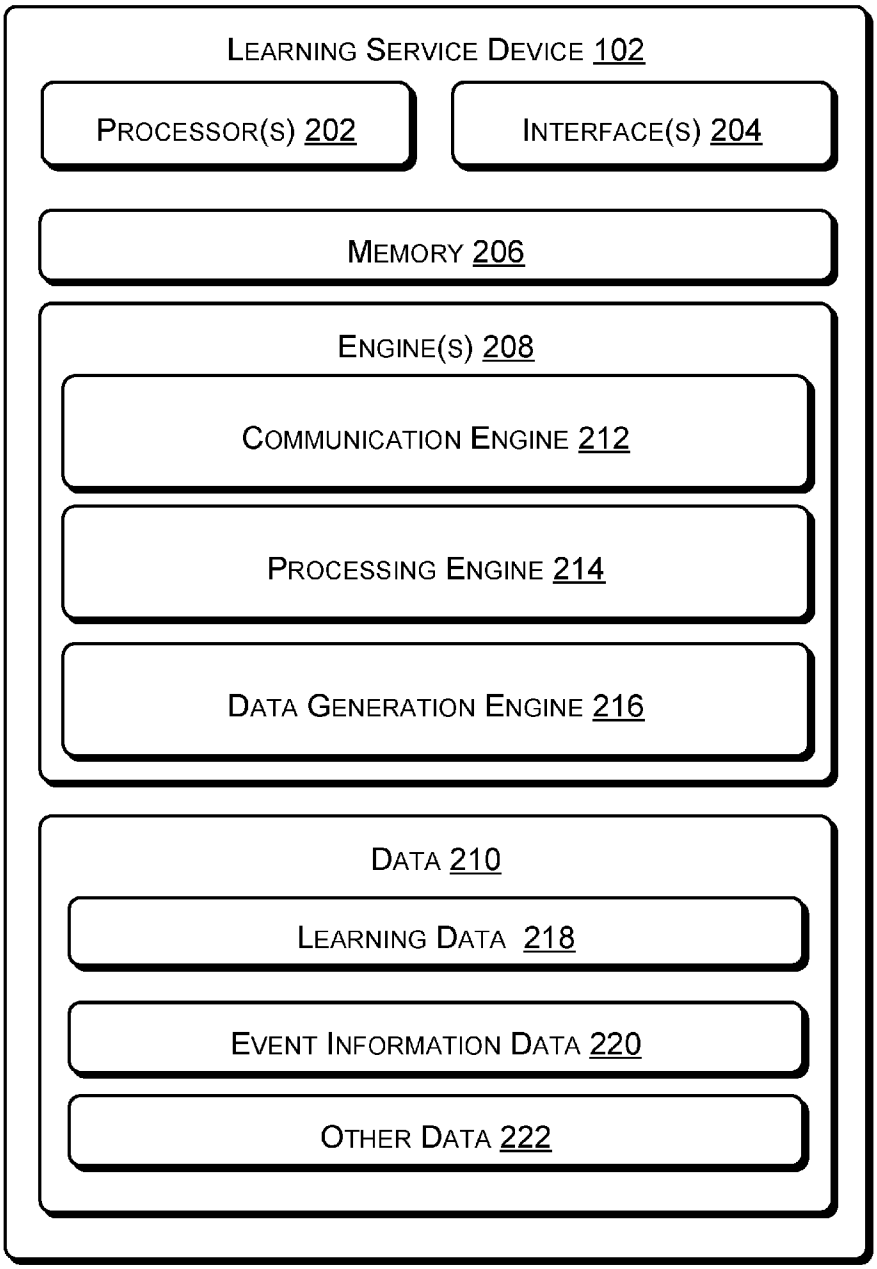

LEARNING SERVICE DEVICE 102
PROCESSOR(S) 202
INTERFACE(S) 204
MEMORY 206
ENGINE(S) 208
COMMUNICATION ENGINE 212
PROCESSING ENGINE 214
DATA GENERATION ENGINE 216
DATA 210
LEARNING DATA 218
EVENT INFORMATION DATA 220
OTHER DATA 222

Fig. 2

[Fig. 3]

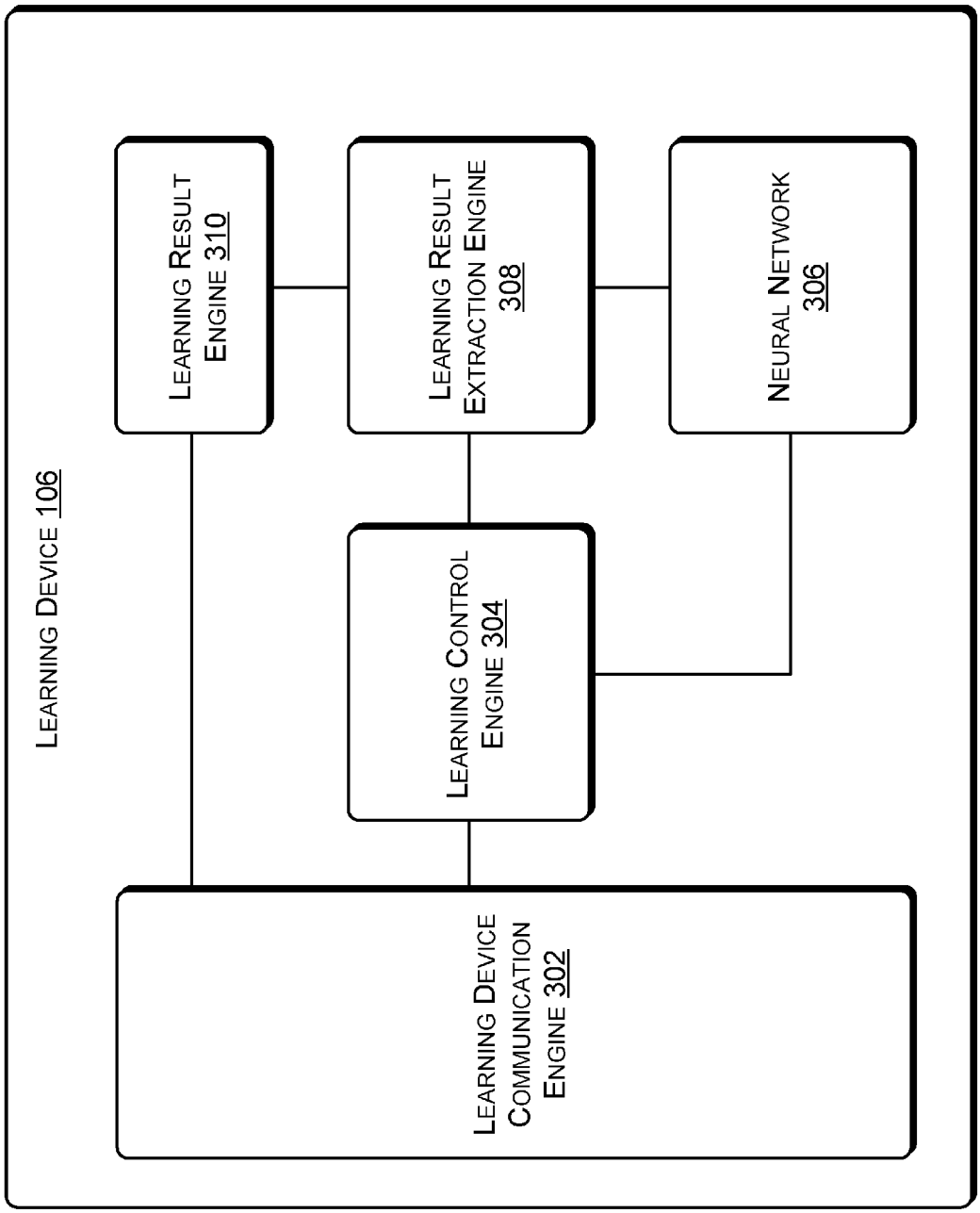

LEARNING DEVICE 106
LEARNING RESULT ENGINE 310
LEARNING RESULT EXTRACTION ENGINE 308
NEURAL NETWORK 306
LEARNING CONTROL ENGINE 304
LEARNING DEVICE COMMUNICATION ENGINE 302

Fig. 3

[Fig. 4]

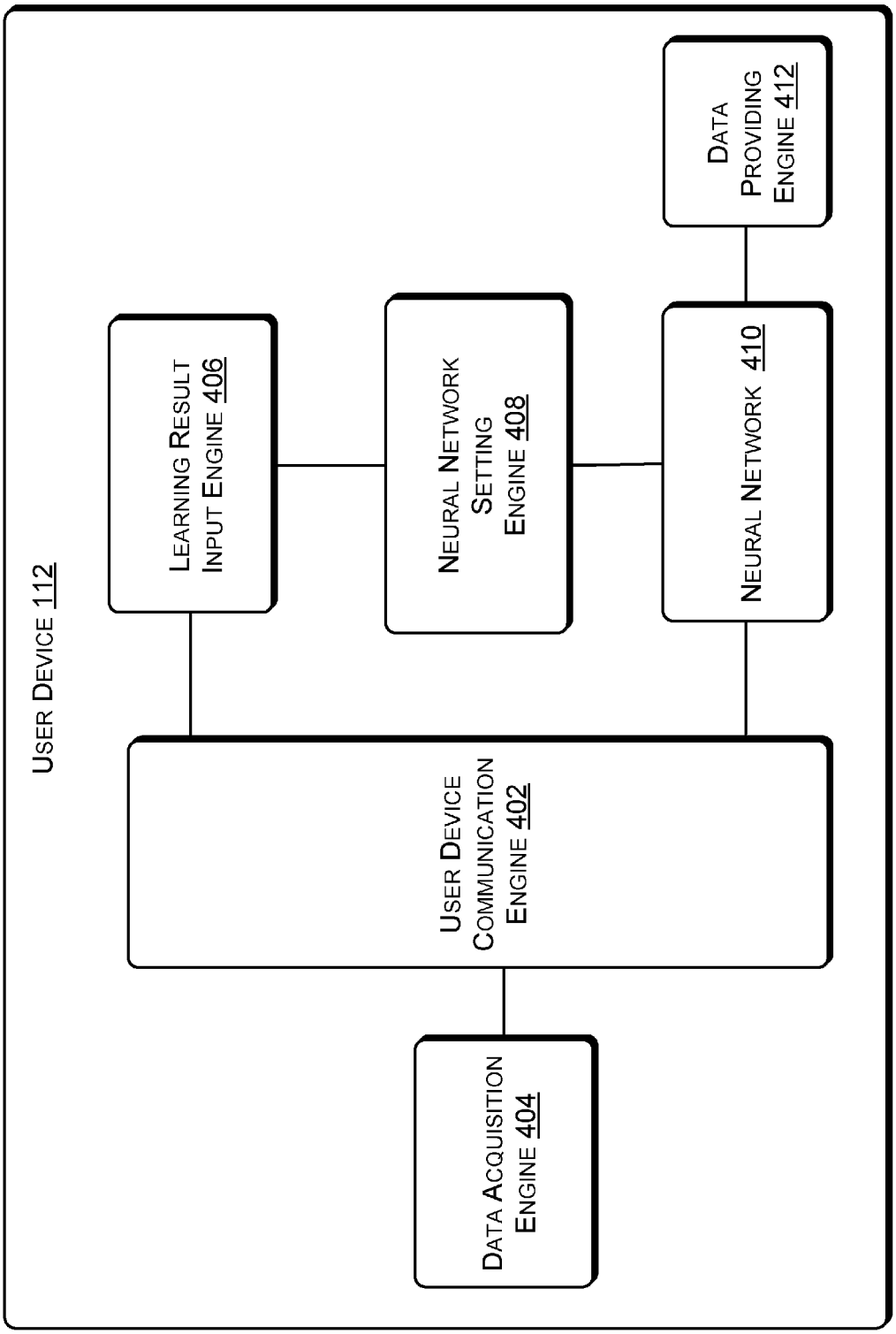

USER DEVICE 112
LEARNING RESULT INPUT ENGINE 406
NEURAL NETWORK SETTING ENGINE 408
DATA PROVIDING ENGINE 412
NEURAL NETWORK 410
USER DEVICE COMMUNICATION ENGINE 402
DATA ACQUISITION ENGINE 404

Fig. 4

[Fig. 5]

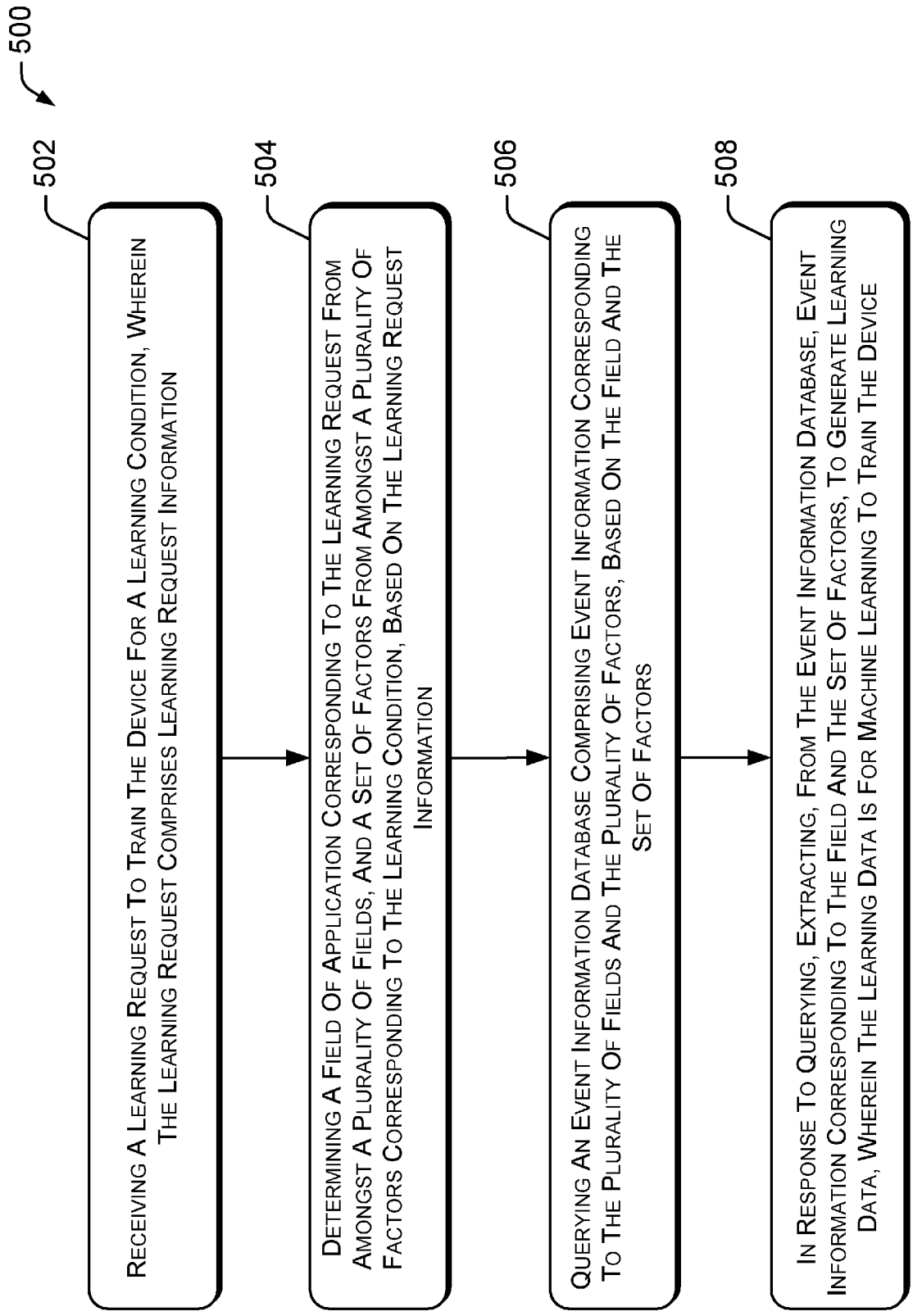

500
502
RECEIVING A LEARNING REQUEST TO TRAIN THE DEVICE FOR A LEARNING CONDITION, WHEREIN THE LEARNING REQUEST COMPRISES LEARNING REQUEST INFORMATION
504
DETERMINING A FIELD OF APPLICATION CORRESPONDING TO THE LEARNING REQUEST FROM AMONGST A PLURALITY OF FIELDS, AND A SET OF FACTORS FROM AMONGST A PLURALITY OF FACTORS CORRESPONDING TO THE LEARNING CONDITION, BASED ON THE LEARNING REQUEST INFORMATION
506
QUERYING AN EVENT INFORMATION DATABASE COMPRISING EVENT INFORMATION CORRESPONDING TO THE PLURALITY OF FIELDS AND THE PLURALITY OF FACTORS, BASED ON THE FIELD AND THE SET OF FACTORS
508
IN RESPONSE TO QUERYING, EXTRACTING, FROM THE EVENT INFORMATION DATABASE, EVENT INFORMATION CORRESPONDING TO THE FIELD AND THE SET OF FACTORS, TO GENERATE LEARNING DATA, WHEREIN THE LEARNING DATA IS FOR MACHINE LEARNING TO TRAIN THE DEVICE

Fig. 5

[Fig. 6]

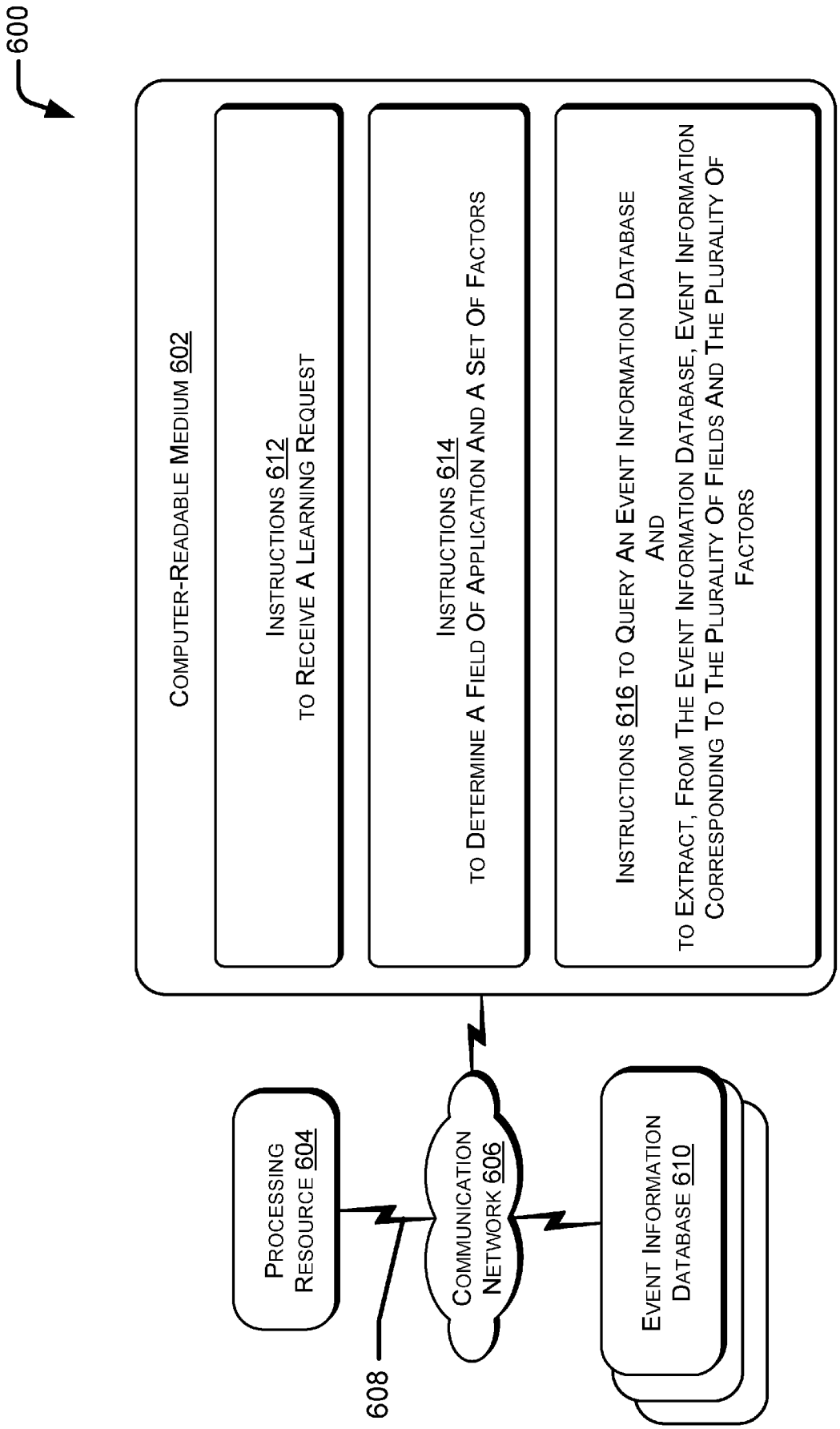

600
COMPUTER-READABLE MEDIUM 602
INSTRUCTIONS 612
TO RECEIVE A LEARNING REQUEST
INSTRUCTIONS 614
TO DETERMINE A FIELD OF APPLICATION AND A SET OF FACTORS
INSTRUCTIONS 616 TO QUERY AN EVENT INFORMATION DATABASE
AND
TO EXTRACT, FROM THE EVENT INFORMATION DATABASE, EVENT INFORMATION
CORRESPONDING TO THE PLURALITY OF FIELDS AND THE PLURALITY OF
FACTORS
PROCESSING RESOURCE 604
608
COMMUNICATION NETWORK 606
EVENT INFORMATION DATABASE 610

Fig. 6

INTERNATIONAL SEARCH REPORT

International application No
PCT/JP2017/009851

A. CLASSIFICATION OF SUBJECT MATTER
INV. G06F19/00
ADD.

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)
G06F

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

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP 2 357 582 A1 (HEALTH DISCOVERY CORP [US]) 17 August 2011 (2011-08-17) paragraph [0044] paragraph [0076] - paragraph [0091] figure 12 -----	1-15

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

☒ See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
21 November 2017	29/11/2017

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Wittke, Claudia

1

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/JP2017/009851

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP 2357582 A1	17-08-2011	AU 779635 B2	03-02-2005
		CA 2388595 A1	03-05-2001
		EP 1236173 A2	04-09-2002
		EP 2357582 A1	17-08-2011
		JP 5064625 B2	31-10-2012
		JP 2003529131 A	30-09-2003
		WO 0131580 A2	03-05-2001