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(54) **ROBOT CONTROL METHOD AND INFORMATION PROVIDING METHOD**

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(57) **ABSTRACT**

A method for a first server, which controls a robot, includes: acquiring, from a second server, request information that indicates a request for an action of the robot after the second server determines that it is required to encourage the user to exercise; if it is confirmed that the second server has an access right to make the robot perform the request, making a decision for one of an action group including at least two of execution, suspension, or rejection of the request; and after the decision to execute the request is made, transmitting, to the robot, instruction information that causes the robot to take an action for encouraging the user to exercise.

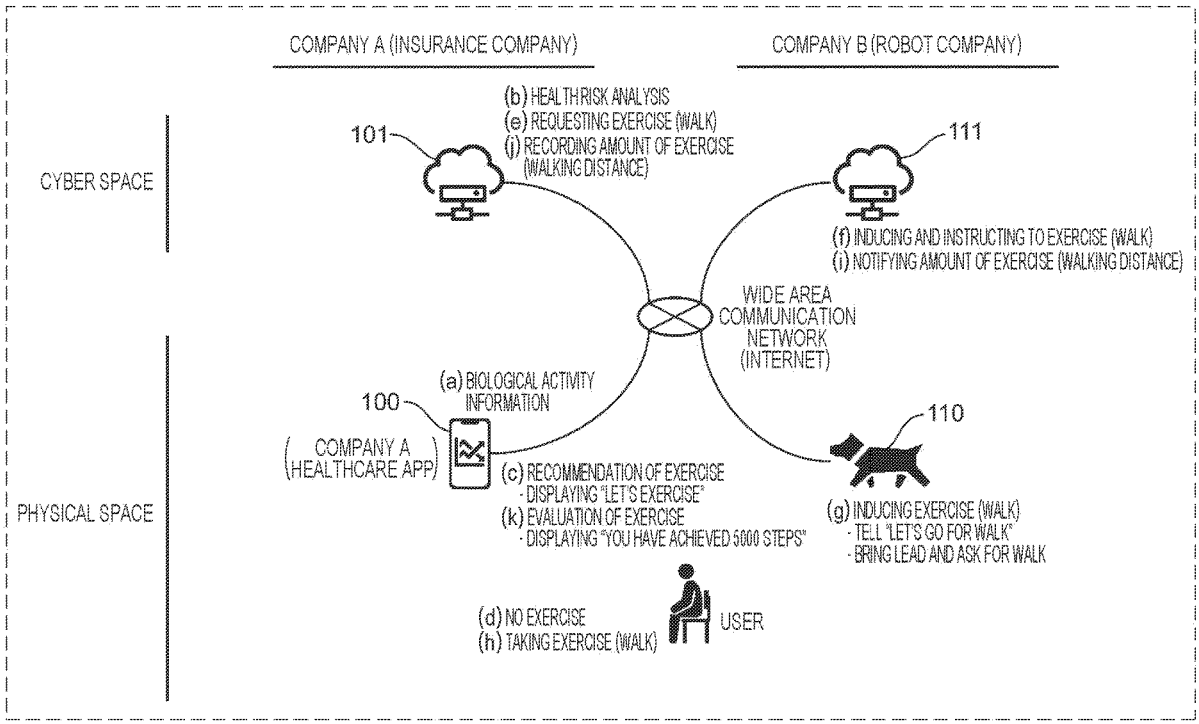


FIG. 1

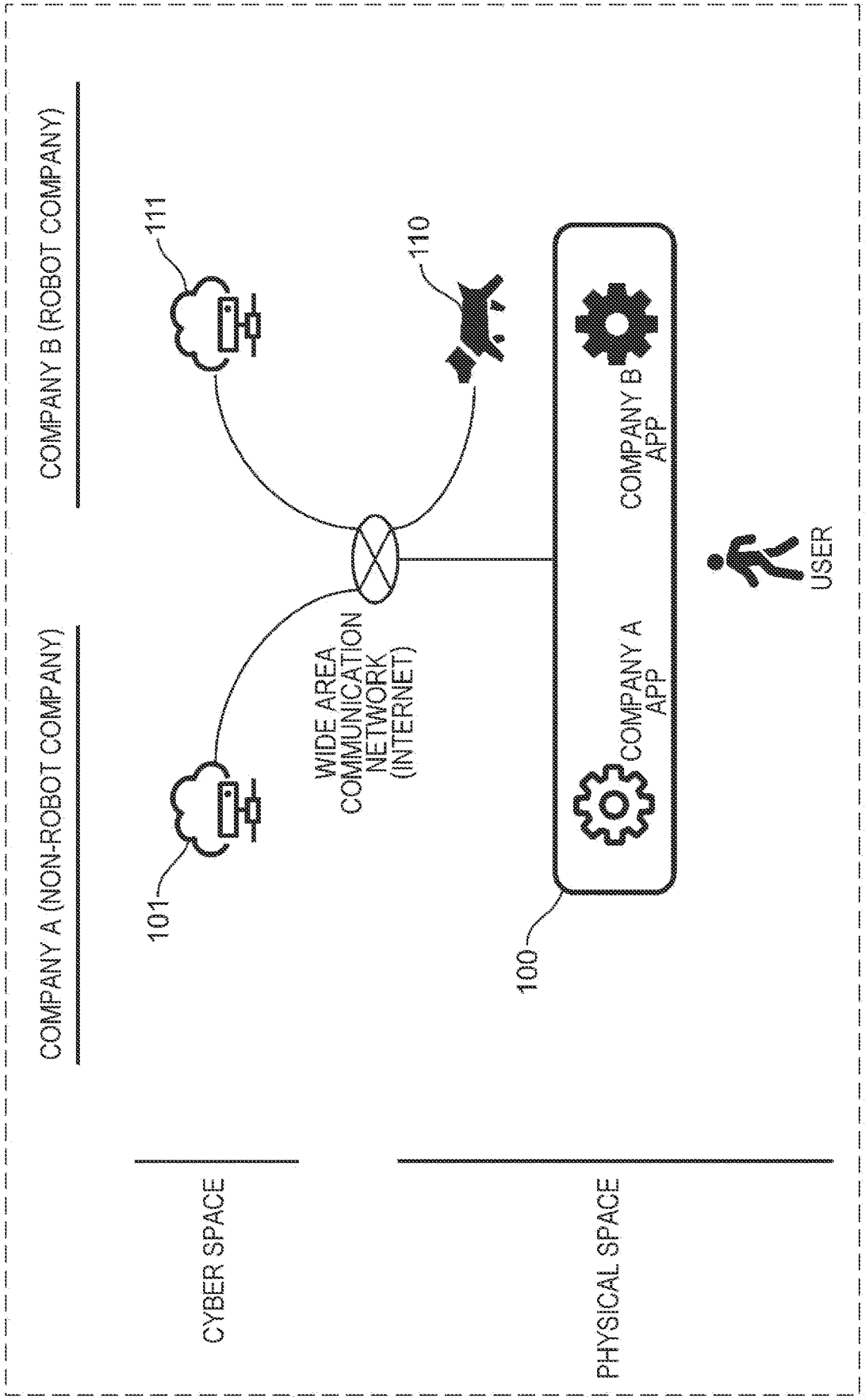

COMPANY A (NON-ROBOT COMPANY)
COMPANY B (ROBOT COMPANY)
CYBER SPACE
PHYSICAL SPACE
101
111
110
100
WIDE AREA COMMUNICATION NETWORK (INTERNET)
COMPANY A APP
COMPANY B APP
USER

FIG. 2

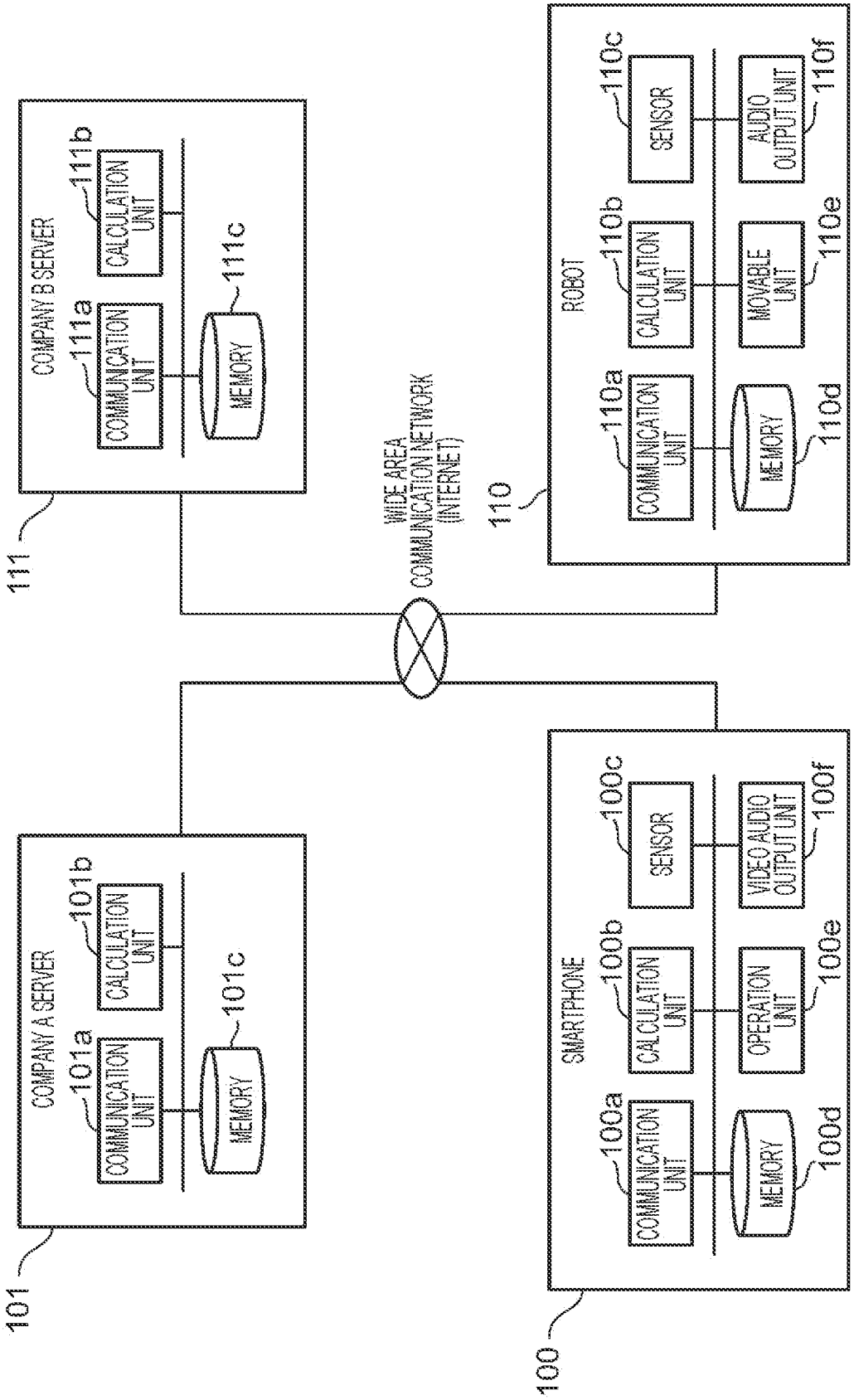

101
COMPANY A SERVER
101a
COMMUNICATION UNIT
101b
CALCULATION UNIT
101c
MEMORY
111
COMPANY B SERVER
111a
COMMUNICATION UNIT
111b
CALCULATION UNIT
111c
MEMORY
WIDE AREA COMMUNICATION NETWORK (INTERNET)
110
ROBOT
110a
COMMUNICATION UNIT
110b
CALCULATION UNIT
110c
SENSOR
110d
MEMORY
110e
MOVABLE UNIT
110f
AUDIO OUTPUT UNIT
100
SMARTPHONE
100a
COMMUNICATION UNIT
100b
CALCULATION UNIT
100c
SENSOR
100d
MEMORY
100e
OPERATION UNIT
100f
VIDEO AUDIO OUTPUT UNIT

FIG. 3

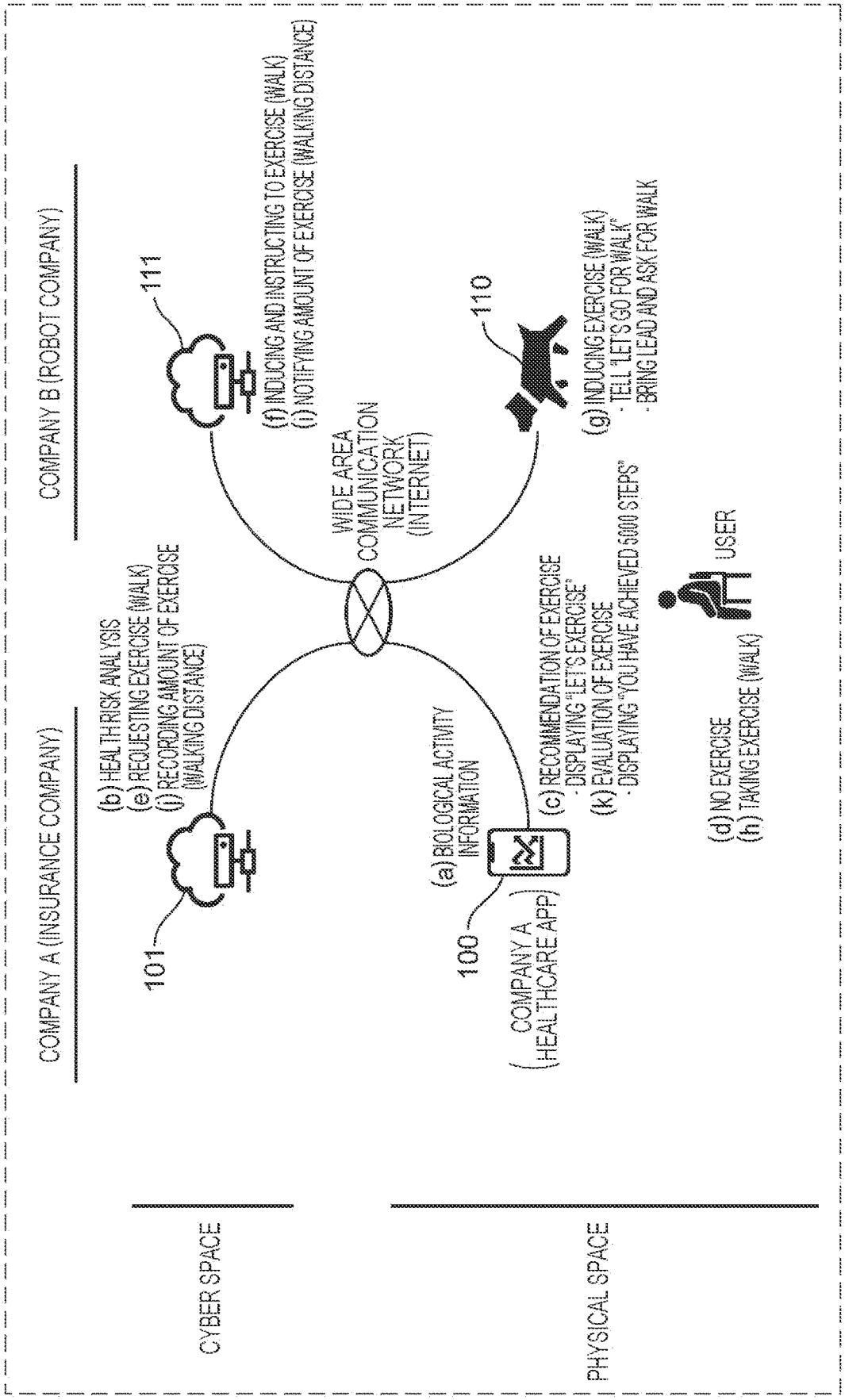

CYBER SPACE
PHYSICAL SPACE
COMPANY A (INSURANCE COMPANY)
COMPANY B (ROBOT COMPANY)
101
111
100
110
(b) HEALTH RISK ANALYSIS
(e) REQUESTING EXERCISE (WALK)
(i) RECORDING AMOUNT OF EXERCISE (WALKING DISTANCE)
(f) INDUCING AND INSTRUCTING TO EXERCISE (WALK)
(i) NOTIFYING AMOUNT OF EXERCISE (WALKING DISTANCE)
WIDE AREA COMMUNICATION NETWORK (INTERNET)
(a) BIOLOGICAL ACTIVITY INFORMATION
COMPANY A (HEALTHCARE APP)
(c) RECOMMENDATION OF EXERCISE
· DISPLAYING "LET'S EXERCISE"
(k) EVALUATION OF EXERCISE
· DISPLAYING "YOU HAVE ACHIEVED 6000 STEPS"
(g) INDUCING EXERCISE (WALK)
· TELL "LET'S GO FOR WALK"
· BRING LEAD AND ASK FOR WALK
(d) NO EXERCISE
(h) TAKING EXERCISE (WALK)
USER

FIG. 4

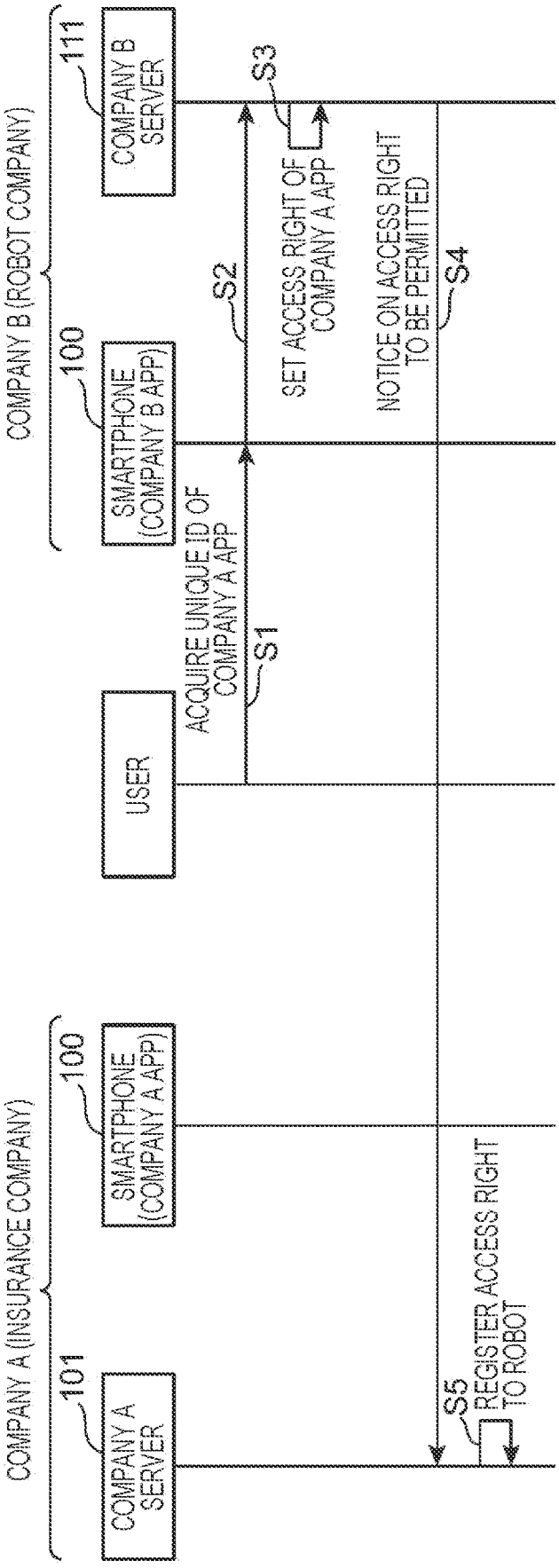

COMPANY B (ROBOT COMPANY)
111
COMPANY B SERVER
100
SMARTPHONE (COMPANY B APP)
USER
ACQUIRE UNIQUE ID OF COMPANY A APP
S1
S2
S3
SET ACCESS RIGHT OF COMPANY A APP
NOTICE ON ACCESS RIGHT TO BE PERMITTED
S4
COMPANY A (INSURANCE COMPANY)
101
COMPANY A SERVER
100
SMARTPHONE (COMPANY A APP)
S5
REGISTER ACCESS RIGHT TO ROBOT

FIG. 5

TYPES OF ACCESS RIGHTS		LEVEL TO BE PERMITTED (DESCRIBE ONLY THOSE OTHER THAN "0: NOT PERMITTED")
TASK	INDUCING TO EXERCISE	1: ONLY LIGHT EXERCISE PERMITTED 2: ALL PERMITTED
	CONVERSATION	1: PERMITTED
SENSOR	CAMERA IMAGE	1: ONLY STILL IMAGES PERMITTED 2: UP TO LOW-QUALITY MOVING IMAGES PERMITTED 3: ALL PERMITTED
	RANGING SENSOR	1: PERMITTED
	INFRARED SENSOR	1: PERMITTED
	MICROPHONE SOUND	1: PERMITTED
	TACTILE SENSOR	1: ONLY PARTIALLY PERMITTED 2: ALL PERMITTED
	AIR TEMPERATURE/HUMIDITY/ BAROMETRIC PRESSURE SENSOR	1: PERMITTED
	POSITION SENSOR	1: PERMITTED
MOTOR ABILITY	ABILITY TO CHANGE FACIAL EXPRESSIONS	1: PERMITTED
	ABILITY TO VOCALIZE	1: PERMITTED
	ABILITY TO CHANGE POSTURE	1: ONLY HEAD PERMITTED 2: ALL PERMITTED
	ABILITY TO MOVE	1: PERMITTED TO MOVE AT LOW SPEED ONLY WITHIN PERMITTED HOUSE 2: PERMITTED TO MOVE AT LOW SPEED TO INSIDE/OUTSIDE PERMITTED HOUSE 3: PERMITTED TO MOVE AT HIGH SPEED TO INSIDE/OUTSIDE OF PERMITTED HOUSE 4: ALL PERMITTED

FIG. 6

NECESSARY URGENCY DEGREE	REQUESTS TO BE PERMITTED
HIGH	REQUESTS WITH URGENCY CONCERNING LIFE, HEALTH, DANGER, OR RISK OF PROPERTY LOSS ARE PROCESSED. OTHERWISE, REQUEST IS SUSPENDED OR REJECTED.
MEDIUM	IN ADDITION TO REQUESTS WHOSE NECESSARY URGENCY DEGREE IS CLASSIFIED AS "HIGH", REQUESTS NOTIFYING USERS OF IMPORTANT INFORMATION IN DAILY LIFE (NOTIFICATION OF NEXT SCHEDULE OR OF STATE AT RISK OF SIGNIFICANT LOSS (SUCH AS LEAVING GAS OVEN ON)) ARE PROCESSED. OTHERWISE, REQUEST IS SUSPENDED OR REJECTED.
LOW	ALL REQUESTS ARE PROCESSED.

FIG. 7

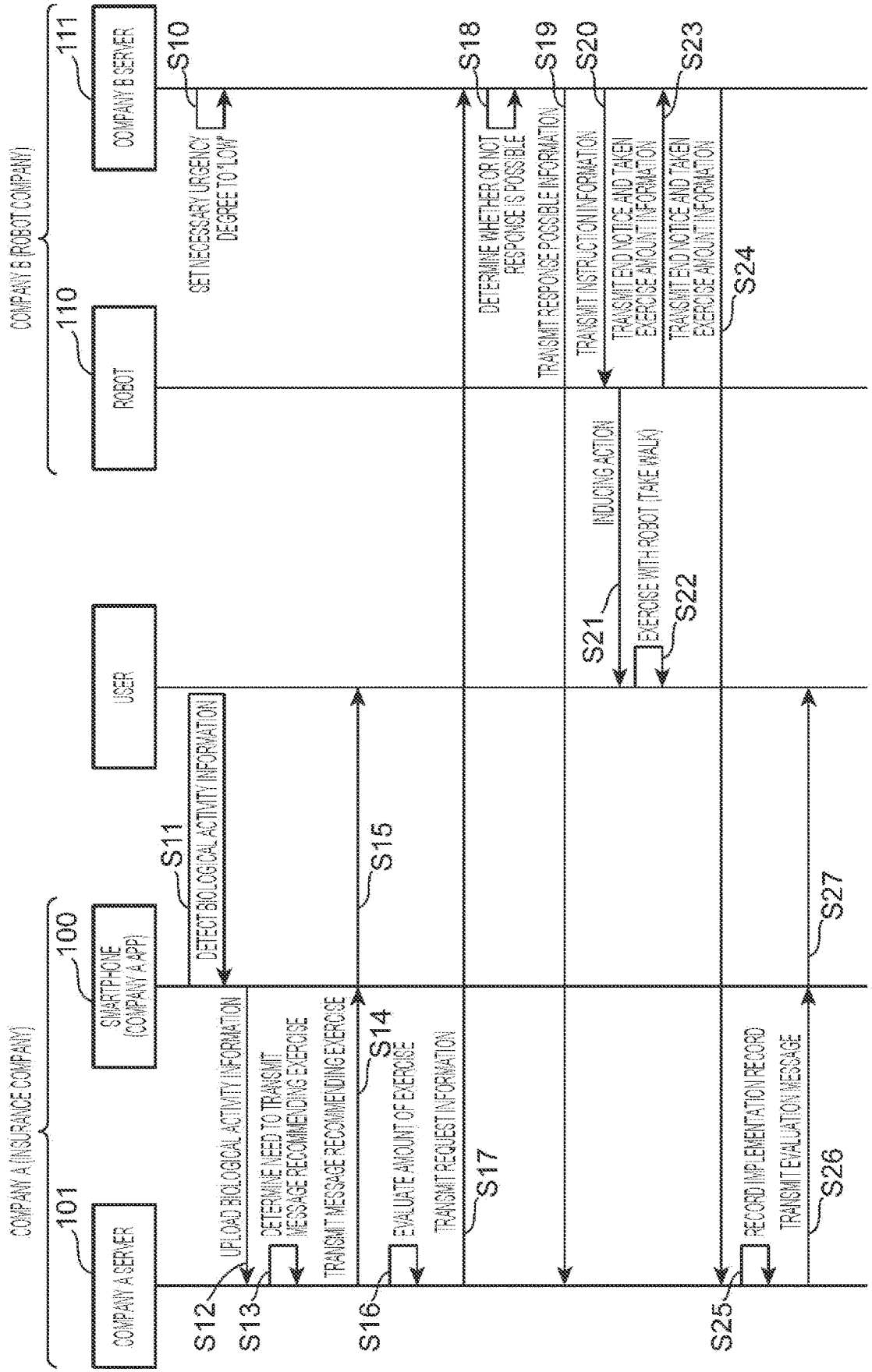

COMPANY A (INSURANCE COMPANY)
101
COMPANY A SERVER
100
SMARTPHONE (COMPANY A APP)
USER
COMPANY B (ROBOT COMPANY)
110
ROBOT
111
COMPANY B SERVER
S10
SET NECESSARY URGENCY DEGREE TO "LOW"
S11
DETECT BIOLOGICAL ACTIVITY INFORMATION
S12
UPLOAD BIOLOGICAL ACTIVITY INFORMATION
S13
DETERMINE NEED TO TRANSMIT MESSAGE RECOMMENDING EXERCISE
S14
TRANSMIT MESSAGE RECOMMENDING EXERCISE
S15
S16
EVALUATE AMOUNT OF EXERCISE
S17
TRANSMIT REQUEST INFORMATION
S18
DETERMINE WHETHER OR NOT RESPONSE IS POSSIBLE
S19
TRANSMIT RESPONSE POSSIBLE INFORMATION
S20
TRANSMIT INSTRUCTION INFORMATION
S21
INDUCING ACTION
S22
EXERCISE WITH ROBOT (TAKE WALK)
S23
TRANSMIT END NOTICE AND TAKEN EXERCISE AMOUNT INFORMATION
S24
TRANSMIT END NOTICE AND TAKEN EXERCISE AMOUNT INFORMATION
S25
RECORD IMPLEMENTATION RECORD
S26
TRANSMIT EVALUATION MESSAGE
S27

FIG. 8

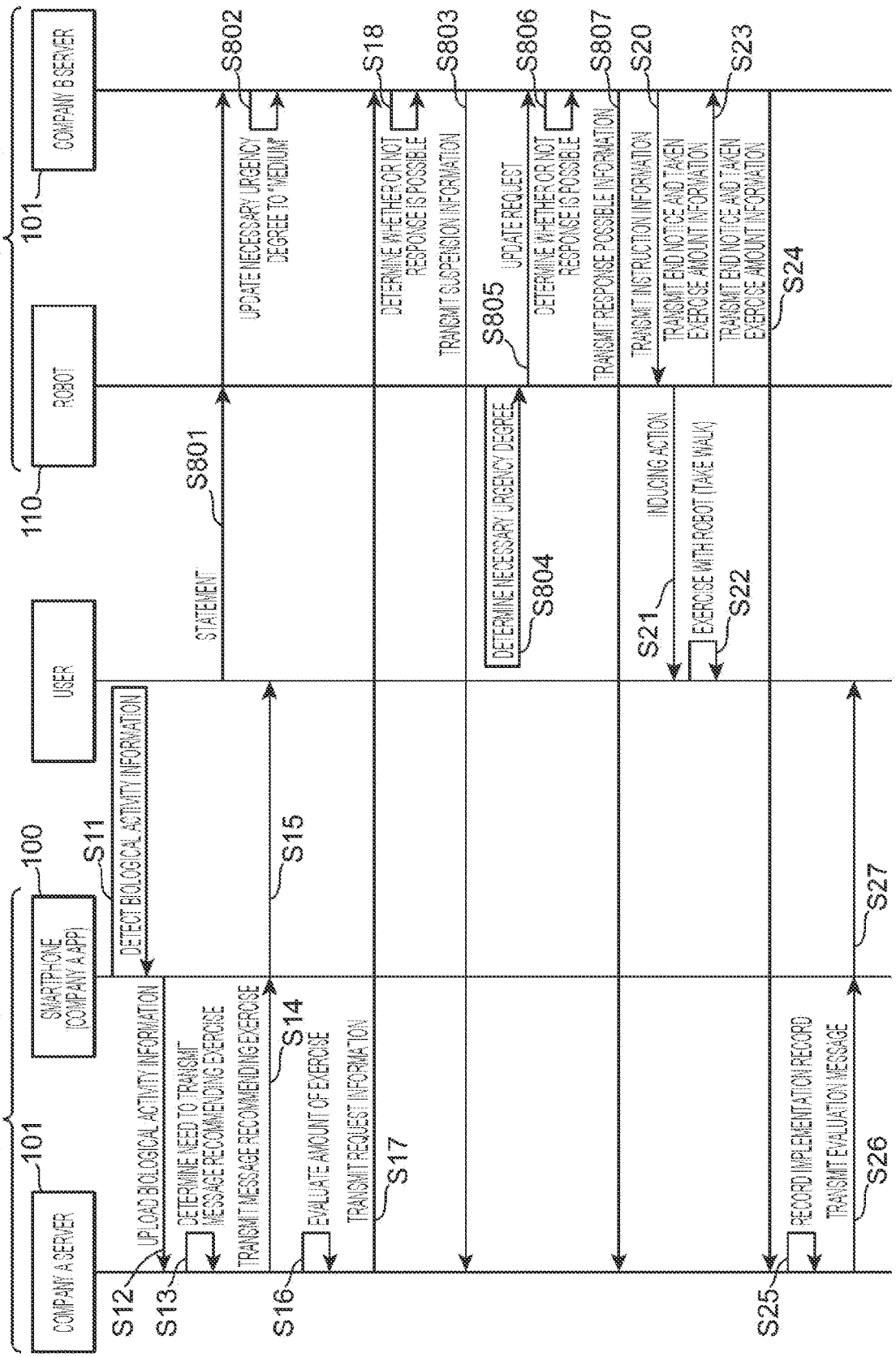

COMPANY A (INSURANCE COMPANY)
COMPANY B (ROBOT COMPANY)
101
COMPANY A SERVER
100
SMARTPHONE (COMPANY A APP)
USER
110
ROBOT
101
COMPANY B SERVER
S11
DETECT BIOLOGICAL ACTIVITY INFORMATION
S12
UPLOAD BIOLOGICAL ACTIVITY INFORMATION
S13
DETERMINE NEED TO TRANSMIT MESSAGE RECOMMENDING EXERCISE
S14
TRANSMIT MESSAGE RECOMMENDING EXERCISE
S15
S16
EVALUATE AMOUNT OF EXERCISE
S17
TRANSMIT REQUEST INFORMATION
S801
STATEMENT
S802
UPDATE NECESSARY URGENCY DEGREE TO "MEDIUM"
S18
DETERMINE WHETHER OR NOT RESPONSE IS POSSIBLE
S803
TRANSMIT SUSPENSION INFORMATION
S804
DETERMINE NECESSARY URGENCY DEGREE
S805
UPDATE REQUEST
S806
DETERMINE WHETHER OR NOT RESPONSE IS POSSIBLE
S807
TRANSMIT RESPONSE POSSIBLE INFORMATION
S20
TRANSMIT INSTRUCTION INFORMATION
S21
INDUCING ACTION
S22
EXERCISE WITH ROBOT (TAKE WALK)
S23
TRANSMIT END NOTICE AND TAKEN EXERCISE AMOUNT INFORMATION
S24
TRANSMIT END NOTICE AND TAKEN EXERCISE AMOUNT INFORMATION
S25
RECORD IMPLEMENTATION RECORD
S26
TRANSMIT EVALUATION MESSAGE
S27

FIG. 9

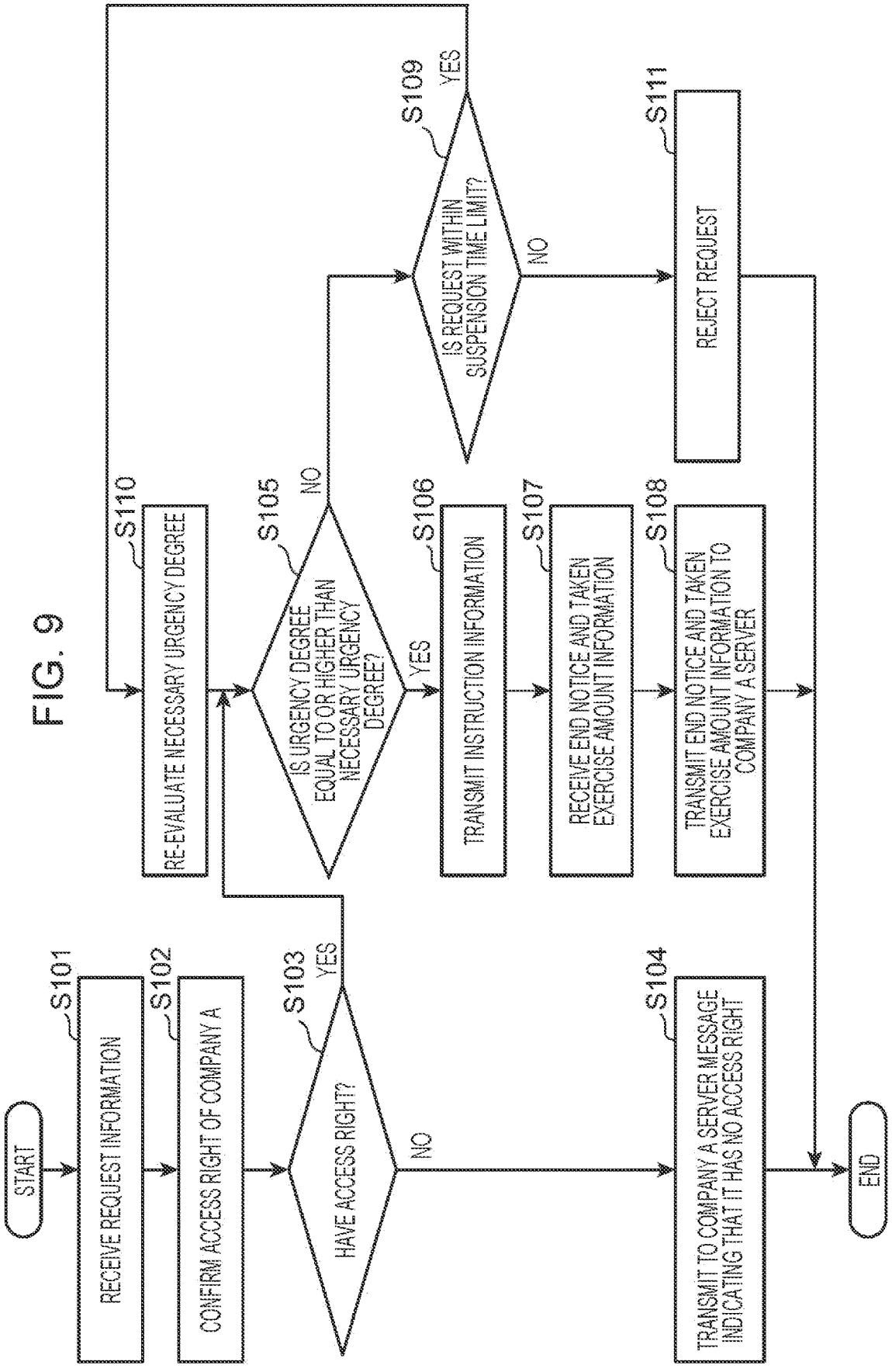

START
S101
RECEIVE REQUEST INFORMATION
S102
CONFIRM ACCESS RIGHT OF COMPANY A
S103
HAVE ACCESS RIGHT?
YES
NO
S104
TRANSMIT TO COMPANY A SERVER MESSAGE INDICATING THAT IT HAS NO ACCESS RIGHT
S105
IS URGENCY DEGREE EQUAL TO OR HIGHER THAN NECESSARY URGENCY DEGREE?
YES
NO
S106
TRANSMIT INSTRUCTION INFORMATION
S107
RECEIVE END NOTICE AND TAKEN EXERCISE AMOUNT INFORMATION
S108
TRANSMIT END NOTICE AND TAKEN EXERCISE AMOUNT INFORMATION TO COMPANY A SERVER
S109
IS REQUEST WITHIN SUSPENSION TIME LIMIT?
YES
NO
S110
RE-EVALUATE NECESSARY URGENCY DEGREE
S111
REJECT REQUEST
END

FIG. 10

TIME ZONE	USER'S STATE	UPDATING OF NECESSARY URGENCY DEGREE BY ROBOT	NECESSARY URGENCY DEGREE
8:00–10:00	 TALKING	USING SENSOR, ROBOT DETECTS THAT USER IS TALKING WITH ANOTHER PERSON, AND SETS NECESSARY URGENCY DEGREE TO "MEDIUM". FURTHERMORE, BASED ON RESULT OF SENTIMENT ANALYSIS OF USER, ROBOT MAY CHANGE NECESSARY URGENCY DEGREE.	MEDIUM
10:00–12:00	 WORKING	USING SENSOR, ROBOT DETECTS THAT USER IS OPERATING PERSONAL COMPUTER, AND MAINTAINS THE NECESSARY URGENCY DEGREE AT "MEDIUM".	MEDIUM
12:00–13:00	 HAVING MEAL	USING SENSOR, ROBOT DETECTS THAT USER IS HAVING MEAL, AND UPDATES NECESSARY URGENCY DEGREE TO "LOW".	LOW
13:00–15:00	 ON PHONE/IN MEETING	USING SENSOR, ROBOT DETECTS THAT USER IS TALKING OR IN MEETING VIA MOBILE PHONE OR PERSONAL COMPUTER, AND UPDATES NECESSARY URGENCY DEGREE TO "MEDIUM".	MEDIUM
15:00–16:00	 EXERCISING	USING SENSOR, ROBOT DETECTS THAT USER IS EXERCISING, AND MAINTAINS NECESSARY URGENCY DEGREE AT "MEDIUM". FURTHERMORE, WHEN THERE IS PERIODIC CHANGE IN USER'S SKIN COLOR OR WHEN HEART RATE IS LOW, ROBOT MAY UPDATE NECESSARY URGENCY DEGREE TO "LOW".	MEDIUM
16:00–20:00	 RELAXING	USING SENSOR, ROBOT DETECTS THAT USER IS RELAXING STATE, AND UPDATES NECESSARY URGENCY DEGREE TO "LOW".	LOW

ROBOT CONTROL METHOD AND INFORMATION PROVIDING METHOD

BACKGROUND

1. Technical Field

[0001] The present disclosure relates to a technique that provides robot capabilities to the outside.

2. Description of the Related Art

[0002] Japanese Patent No. 6495486 (referred to as PTL 1) discloses a method, as an autonomous robot that considers physical conditions of a user, of measuring body temperatures of the user and determining the user's condition based on a cycle of the measured body temperatures, and a method of changing an amount of operation of the robot when a basal temperature cycle reaches a predetermined timing.

SUMMARY

[0003] The technique of PTL 1 needs further improvement, however.

[0004] In one general aspect, the techniques disclosed here feature a method for a first server that communicates with a robot and controls the robot, including: acquiring, from a second server, request information that indicates a request for an action of the robot and that includes urgency degree information indicating a first urgency degree for the user to exercise, wherein the second server determines whether or not it is required to encourage a user to exercise based on biological activity information acquired from an information terminal of the user, the biological activity information indicating biological activity of the user, and wherein the request information is transmitted from the second server after the second server determines that it is required to encourage the user to exercise; if it is confirmed at the first server that the second server has an access right to make the robot perform the request indicated by the request information, making a decision for one of an action group including at least two of execution, suspension, or rejection of the request based on i) the urgency degree information and ii) necessary urgency degree information that is managed at the first server, wherein the necessary urgency degree information indicates a second urgency degree that is required for the robot to execute the request; and after the decision to execute the request is made, transmitting, to the robot, instruction information that causes the robot to take an action for encouraging the user to exercise.

[0005] According to the present disclosure, further improvement is possible.

[0006] Additional benefits and advantages of the disclosed embodiments will become apparent from the specification and drawings. The benefits and/or advantages may be individually obtained by the various embodiments and features of the specification and drawings, which need not all be provided in order to obtain one or more of such benefits and/or advantages.

BRIEF DESCRIPTION OF THE DRAWINGS

[0007] FIG. **1** is a block diagram illustrating an example of an overall configuration of an information system according to an embodiment of the present disclosure;

[0008] FIG. **2** is a block diagram illustrating an example of the configuration of the information system according to the embodiment of the present disclosure;

[0009] FIG. **3** is a block diagram illustrating an example of an overall configuration of an information system according to a form of one form of the present disclosure;

[0010] FIG. **4** is a flowchart illustrating an example of processing when a non-robot company (company A) works with a robot;

[0011] FIG. **5** is a table illustrating an example of setting information of an access right about a robot;

[0012] FIG. **6** is a table illustrating an example of level of urgency degree for determining whether or not it is possible to execute a requested task;

[0013] FIG. **7** is a flowchart illustrating an example of processing in which the non-robot company requests a task from the robot;

[0014] FIG. **8** is a flowchart illustrating an example of processing in which the non-robot company requests a task from the robot;

[0015] FIG. **9** is a flowchart illustrating an example of processing of a company B server; and

[0016] FIG. **10** is a table illustrating an example of setting of necessary urgency degree.

DETAILED DESCRIPTIONS

(Underlying Knowledge Forming Basis of the Present Disclosure)

[0017] Our daily lives have been increasingly digitalized. For example, many people have smartphones that are information communication terminals dedicated for private use. Users have come to install in smartphones and to use various applications (an application is hereinafter referred to as an app), such as an app for performing their health management, an app for family budget management, a social communication app for supporting real-time communications with acquaintances, and a news app that curates news in the world in accordance with interests of an individual.

[0018] On the other hand, but gradually, a movable device (hereinafter referred to as a robot) capable of autonomously performing various operations or tasks has been put into practice. Those robots are robots that assemble or adjust parts in factories, robots that perform accurate and quick sorting at physical distribution bases, robots that fulfill specific tasks in light of surrounding circumstances, or the like. These robots also include robots that perform work in cooperation with humans or that perform a specific task on behalf of humans.

[0019] The present disclosure proposes a technique for assisting users so that the users can lead a healthy, happy, comfortable, secured, safe, enjoyable, and/or clean life, by a smartphone and a robot, which is a mobile device, operating in cooperation with each other, the smartphone being an information processing device capable of performing various information processing, and the mobile device capable of executing tasks that handle various operations and objects.

[0020] If biological activity information of a user is collected and it is confirmed from the collected biological activity information that the user lacks exercise, it is possible to urge the user to exercise by presenting a message inducing

the user to exercise through the user's smartphone. A message prompting the users to change their behavior in this manner is called a nudge.

[0021] However, it is not easy to cause the users who do not have an exercise habit to change their behavior. Simply presenting the nudge to the users is not sufficient and a stronger motivation than the nudge is needed.

[0022] In PTL 1 described above, there is disclosed a technique for estimating, from owner's body temperatures, timing of consideration when a robot should give consideration to an owner, in view of an owner's menstrual cycle and for causing the robot, which usually behaves on its own, to behave considerately, such as staring at the owner at the estimated consideration timing, thereby enhancing sympathy of the owner for the robot.

[0023] As such, since PTL 1 is the technique of enhancing the sympathy between the owner and the robot, it is not possible to give users a strong motivation for exercise.

[0024] The present disclosure has been made to solve such a problem and aims to provide a technique that can give users a strong motivation for exercise.

[0025] A method according to one aspect of the present disclosure is a method for a first server that communicates with a robot and controls the robot, including: acquiring, from a second server, request information that indicates a request for an action of the robot and that includes urgency degree information indicating a first urgency degree for the user to exercise, wherein the second server determines whether or not it is required to encourage a user to exercise based on biological activity information acquired from an information terminal of the user, the biological activity information indicating biological activity of the user, and wherein the request information is transmitted from the second server after the second server determines that it is required to encourage the user to exercise; if it is confirmed at the first server that the second server has an access right to make the robot perform the request indicated by the request information, making a decision for one of an action group including at least two of execution, suspension, or rejection of the request based on i) the urgency degree information and ii) necessary urgency degree information that is managed at the first server, wherein the necessary urgency degree information indicates a second urgency degree that is required for the robot to execute the request; and after the decision to execute the request is made, transmitting, to the robot, instruction information that causes the robot to take an action for encouraging the user to exercise.

[0026] According to the aspect described above, it is possible, through the access right, to cause the second server that does not manage the robot to temporarily utilize capabilities of the robot managed by the first server. This allows the second server to encourage the user to exercise through the robot managed by the first server when it is determined that it is required to encourage the user to exercise. As a result, the second server can cause the robot to perform the operation to encourage the user to exercise even though the second server itself does not manage the robot. Therefore, it is possible to give the user the stronger motivation to exercise, for example, when compared with a case where a message prompting the user to exercise is merely displayed on the display of the user's information terminal.

[0027] In the method described above, the decision to execute the request may be made, if the first urgency degree indicated by the urgency degree information is equal to or higher than the second urgency degree indicated by the necessary urgency degree information.

[0028] According to the aspect described above, a request is executed if the urgency degree indicated by the urgency degree information is equal to or higher than the urgency degree indicated by the necessary urgency degree information. Thus, the robot can perform the action to urge the user to exercise, in a time zone other than the time zone during which the user concentrates on working, for example. This can prevent the robot from taking the action to urge the user to exercise at a timing when the user cannot exercise.

[0029] In the method described above, a decision to suspend or reject the request may be made, if the first urgency degree indicated by the urgency degree information is less than the second urgency degree indicated by the necessary urgency degree information.

[0030] According to the aspect described above, if the urgency degree indicated by the urgency degree information is less than the urgency degree indicated by the necessary urgency degree information, the request is suspended or rejected. This makes it possible to prevent the robot from taking the action to urge the user to exercise, in a situation where the user does not have time to care about the robot, such as when the user concentrates on working.

[0031] In the method described above, the request information may further include suspension period information indicating a suspension period during which a decision on the request indicated by the request information can be suspended, and a decision to reject the request may be made, if, during the suspension period, the first urgency degree indicated by the urgency degree information is not equal to or higher than the second urgency degree indicated by the necessary urgency degree information.

[0032] According to the aspect described above, the request is rejected if the urgency degree indicated by the urgency degree information in not equal to or higher than the urgency degree indicated by the necessary urgency degree information during the suspension period. Thus, it is possible to prevent the robot from taking the action to urge the user to exercise in a situation where the user's state is not appropriate for the urging of exercise. For example, it is possible to prevent the robot from taking the action to urge the user to exercise after late at night.

[0033] In the method described above, the request information may further include suspension period information indicating a suspension period during which a decision on the request indicated by the request information can be suspended, and the decision to execute the request may be made, if, during the suspension period, the first urgency degree indicated by the urgency degree information is equal to or higher than the second urgency degree indicated by the necessary urgency degree information.

[0034] According to the aspect described above, the request is executed when the urgency degree indicated by the urgency degree information is equal to or higher than the urgency degree indicated by the necessary urgency degree information. Thus, it is possible to cause the robot to take the action to urge the user to exercise when the user's state is appropriate for the urging. In addition, since such a determination is made in the suspension period, the robot can urge exercise only in the suspension period, rather than urging exercise indefinitely.

[0035] In the method described above, the second urgency degree may be determined based on information indicating a statement made by the user toward the robot, the statement being obtained based on a sensing result of a sensor provided on the robot, and if the statement includes a word with an intention of not communicating with the robot, the second urgency degree may be increased to a predetermined level.

[0036] According to the aspect described above, when the user makes the statement with an intention of not communicating with the robot, the urgency degree indicated by the necessary urgency degree information is increased. Thus, it becomes difficult to execute the request. Consequently, if the user is in the situation where the user is busy and does not have time to care about the robot, it is possible to avoid execution of the request by the robot simply by making the statement with the intention of not communicating.

[0037] In the method described above, the second urgency degree may be determined based on information indicating an answer made by the user to a question, the information being acquired by the robot, and the question may be outputted from a speaker of the robot and is a question to confirm with the user the second urgency degree.

[0038] According to the aspect described above, the urgency degree indicated by the necessary urgency degree information is determined according to the answer to the question for confirming with the user the urgency degree indicated by the necessary urgency degree information. Thus, it is possible to avoid the execution of the request by the robot, for example, in a situation where the user does not want to be involved with the robot.

[0039] In the method described above, the second urgency degree may be determined based on behavior of the user that is obtained by analyzing an image of the user acquired from the sensor provided on the robot, and when the behavior of the user is being on the phone or operating a personal computer, the second urgency degree may be increased to a predetermined level.

[0040] According to the aspect described above, when the user is on the phone or operating the computer and thus in the situation where the user does not care about the robot, it is possible to avoid the execution of the request by the robot.

[0041] In the method described above, the instruction information may further include validity period information indicating a period of validity of the instruction information.

[0042] According to the aspect described above, it is possible to cause the robot to take the action to urge the user to exercise only within the period of validity.

[0043] In the method described above, if time elapsed from the determined timing exceeds the period of validity, the robot may cancel the instruction information without encouraging the user to exercise.

[0044] According to the aspect described above, if time elapsed from timing when it was decided to execute the request exceeds the period of validity, the instruction information is cancelled. Thus, it is possible to prevent the robot from taking the action to urge the user to exercise indefinitely.

[0045] The method described above may further include transmitting, to the second server, taken exercise amount information indicating an amount of exercise taken by the user, after obtaining, from the robot, information indicating that the robot has taken the action indicated in the instruction information to encourage the user to exercise.

[0046] According to the aspect described above, the second server can manage the taken exercise amount information indicating the amount of exercise taken by the user in response to the encouragement by the robot.

[0047] In the method described above, the first server may be managed by a first operator that manages the robot, the second server may be managed by a second operator that manages the biological activity information acquired from the information terminal of the user, and the second operator may be different from the first operator.

[0048] According to the aspect described above, it is possible to cause the second operator that manages the biological activity information of the user to utilize the capabilities of the robot managed by the first operator.

[0049] A method according to another aspect of the present disclosure is a method for a second server that communicates with a first server associated with a robot and communicates with an information terminal of a user, the method including: acquiring biological activity information indicating biological activity of the user from the information terminal of the user; based on the biological activity information, determining whether or not it is required to encourage the user to exercise; and transmitting, to the first server, request information that indicates a request for an action of the robot and that includes urgency degree information indicating a first urgency degree for the user to exercise, after it is determined at the second server that it is required to encourage the user to exercise, wherein if the first server confirms that the second server has an access right to make the robot perform the request by the request information, a decision for one of an action group including at least two of execution, suspension, or rejection of the request is made based on i) the urgency degree information and ii) necessary urgency degree information that is managed by the first server, the necessary urgency degree information indicating a second urgency degree that is required for the robot to execute the request, and wherein instruction information that causes the robot to take an action for encouraging the user to exercise is transmitted from the first server to the robot after the decision to execute the request is made at the first server.

[0050] According to the aspect described above, it is possible to ask the robot to urge the user, from outside of the robot, based on the biological activity of the user, and to cause the robot to encourage the user at an appropriate timing in accordance with the user's state, while dynamically monitoring the user's state via the robot. Consequently, it is possible to utilize the robot to promote the user's exercise beyond the capabilities the robot is provided with, and realize the encouragement for the user to exercise while giving consideration so as not to cause any discomfort to the user.

[0051] In the method described above, the request information may include exercise amount information indicating an amount of exercise required for the user, the amount being calculated based on the biological activity information, the method may include: after the user exercises as a result of the robot encouraging the user to exercise based on the request information, acquiring taken exercise amount information indicating the amount of exercise that the user has taken; creating an evaluation message that evaluates the exercise of the user based on the exercise amount informa-

tion and the taken exercise amount information, and transmitting the evaluation message to the information terminal of the user.

[0052] According to the aspect described above, if the user exercises after being urged by the robot to exercise, the user can share information related to that exercise.

[0053] In the method described above, if it is determined based on the exercise amount information and the taken exercise amount information that the amount of exercise taken by the user may be equal to or larger than an amount of exercise targeted by the user, a message that user has achieved the target amount of exercise is created, as the evaluation message.

[0054] According to the aspect described above, the user can share the message that the user has achieved the target amount of exercise.

[0055] A method according to still another aspect of the present disclosure is a method for a first server that communicates with a robot and controls the robot, including: acquiring, from a second server, request information indicating a request for an action of the robot, wherein the second sever determines whether or not it is required to encourage a user to exercise based on biological activity information acquired from an information terminal of the user, the biological activity information indicating biological activity of the user, and wherein the request information is transmitted from the second server after the second server determines that it is required to encourage the user to exercise; acquiring, from the robot, state data that is detected by the robot and that dynamically changes in relation to a state of the user, and transmitting to the robot, instruction information for causing the robot to take an action for encouraging the user to exercise in response to the request information, after it is determined at the first server that the user is in a state in which the user can be encouraged to exercise based on the request information and the dynamic changes in the state data.

[0056] According to the aspect described above, it is possible to ask the robot to encourage the user, from outside of the robot, thus urging the user to exercise, based on the biological activity of the user, and to cause the robot to encourage the user at an appropriate timing in relation to the user's state, while dynamically monitoring the user's state via the robot. Consequently, it is possible to utilize the robot to promote the user's exercise, and realize the encouragement for the user to exercise while giving consideration so as not to cause any discomfort to the user.

[0057] In the method described above, the request information may further include suspension period information indicating a suspension period during which a determination on the instruction information in response to the request information can be suspended, and a decision to transmit the instruction information may be made, when the user is in the state in which the user can be encouraged to exercise in the suspension period.

[0058] According to the aspect described above, it is possible to cause the robot to take the action to urge the user to exercise when the user is in the appropriate state in which the user may be urged to exercise, within the suspension period. In addition, since such a determination is made during the suspension period, it is possible to urge exercise only within the suspension period, rather than using the robot and urging the exercise indefinitely.

[0059] In the method described above, a decision not to transmit the instruction information may be made, if the user is not in the state in which the user may be encouraged to exercise in the suspension period.

[0060] It is possible to prevent the robot from taking the action to urge the user to exercise, in the state in which it is not appropriate to urge the user to exercise. For example, it is possible to prevent the robot from taking the action to urge the user to exercise, after late at night.

[0061] In the method described above, the request information may include urgency degree information that indicates a first urgency degree for the user to exercise, and the state data may include necessary urgency degree information i) that depends on the dynamic changes in the state data acquired from the robot and ii) that indicates a second urgency degree that is required for the robot to execute the request.

[0062] According to the aspect described above, the request information includes the urgency degree information that indicates the urgency degree for the user to exercise. In addition, since the state data includes the necessary urgency degree information that varies depending on the dynamic change in the state data acquired from the robot, it is possible to cause the robot to take the action to urge the user to exercise, taking into consideration the urgency of the user's exercise.

[0063] In the method described above, it may be determined whether or not the user is in the state in which the user can be encouraged to exercise, based on the urgency degree information and the necessary urgency degree information.

[0064] According to the aspect described above, it is possible to determine whether or not the user is in the state in which the user may be encouraged to exercise, based on the urgency degree information included in the request information as a fixed value based on the user's biological activity acquired from the second server and the necessary urgency degree information that varies depending on a dynamic change in the state data acquired from the robot.

[0065] In the method described above, a decision to transmit the instruction information may be made, when the first urgency degree indicated by the urgency degree information is equal to or higher than the second urgency degree indicated by the necessary urgency degree information.

[0066] According to the aspect described above, a decision to transmit the instruction information can be made if the urgency degree indicated by the urgency degree information is equal to or higher than the urgency degree indicated by the necessary urgency degree information, based on the urgency degree information included in the request information as a fixed value based on the user's biological activity acquired from the second server and the necessary urgency degree information that varies depending on a dynamic change in the state data acquired from the robot. For example, since the instruction information is transmitted to the robot in a time zone other than the time zone during which the user concentrates on working, it is possible to prevent the robot from urging the user to exercise at the timing that the user cannot exercise.

[0067] In the method described above, a decision to suspend the transmission of the instruction information may be made, when the first urgency degree indicated by the urgency degree information is less than the second urgency degree indicated by the necessary urgency degree information.

[0068] According to the aspect described above, a decision to suspend the transmission of the instruction information can be made, when the urgency degree indicated by the urgency degree information is less than the urgency degree indicated by the necessary urgency degree information. For example, since the instruction information is not transmitted to the robot while the user is concentrating on working, the robot does not urge the user to exercise.

[0069] The method described above may further include transmitting the instruction information to the robot, if it is confirmed that the second server has the access right to make the robot perform the request by the request information.

[0070] According to the aspect described above, it is possible to prevent a remote instruction from the outside without the access right to the robot.

[0071] In the method described above, the first server may register registration information indicating whether or not the second server has the access right, and the first server may confirm based on the registration information that the second server has the access right.

[0072] According to the aspect described above, it is possible to prevent a remote instruction from the outside without the access right to the robot.

[0073] A method according to still another aspect of the present disclosure is a method for a second server that communicates with a first server associated with a robot and communicates with an information terminal of a user, the method including: acquiring biological activity information indicating biological activity of the user from the information terminal of the user; based on the biological activity information, determining whether or not it is required to encourage the user to exercise; and transmitting, to the first server, request information indicating a request for an action of the robot after it is determined at the second server that it is required to encourage the user to exercise, wherein, at the first server, state data that is detected by the robot and that dynamically changes in relation to a state of the user is acquired from the robot, and wherein instruction information that causes the robot to take an action for encouraging the user to exercise is transmitted from the first server to the robot in response to the request information after it is determined at the first server based on the request information and the dynamic changes in the state data that the state of the user is a state in which the user can be encouraged to exercise.

[0074] According to the aspect described above, it is possible to ask the robot to encourage the user, from outside of the robot, thus urging the user to exercise, based on the biological activity of the user, and to cause the robot to encourage the user at an appropriate timing in response to the user's state, while dynamically monitoring the user's state via the robot. Consequently, it is possible to utilize the robot to promote the user's exercise beyond the capabilities the robot is provided with, and realize the encouragement for the user to exercise while giving consideration so as not to cause any discomfort to the user.

[0075] In the method described above, the request information may include exercise amount information indicating an amount of exercise required for the user, the amount being calculated based on the biological activity information, the method may include:

[0076] after the user exercises as a result of the robot encouraging the user to exercise based on the request information, acquiring taken exercise amount information indicating the amount of exercise that the user has taken; creating an evaluation message that evaluates the exercise of the user based on the exercise amount information and the taken exercise amount information, and transmitting the evaluation message to the information terminal of the user.

[0077] According to the aspect described above, if the user exercises after being urged by the robot to exercise, the user can share information related to that exercise.

[0078] In the method described above, if it is determined based on the exercise amount information and the taken exercise amount information that the amount of exercise taken by the user is equal to or larger than an amount of exercise targeted by the user, a message that user has achieved the target amount of exercise may created, as the evaluation message.

[0079] According to the above aspect, the user can share the message that the user has achieved the targeted amount of exercise.

[0080] Note that the present disclosure can also realize a program for causing a computer to execute respective characteristic configurations in the method which is used here, or a system operated by this program. In addition, it is needless to say that such a computer program can be distributed through a non-transitory computer readable storage medium such as a CD-ROM or the like, or through a communication network such as Internet or the like.

[0081] Note that any of embodiments described below illustrates a specific example of the present disclosure. Numeric values, shapes, components, steps, or a sequence of steps depicted in the following embodiments are an example, and do not limit the present disclosure. In addition, among components in the following embodiments, components not described in independent claims that represent the highest-level concept are described as arbitrary components. In addition, in all of the embodiments, contents of the respective embodiments can be combined.

Embodiments

[0082] It is expected that in our society, Internet will further spread and various types of sensors will be familiar. As a result, it is expected that our society will be in a state where information on an internal state and activities of individuals or the like as well as information on an entire city including buildings and transportation networks or the like will be digitalized and become available to computer systems. Digitalized data regarding individuals (personal information) will be safely managed as big data in a cloud server such as information banks, via communication networks, and utilized for various purposes for individuals and the society.

[0083] Such an advanced information society is called Society 5.0 in Japan. The advanced information society has an information infrastructure (cyber physical system) that highly integrates a real space (physical space), which is a material world surrounding individuals and a virtual space (cyber space) where computers cooperate with each other to perform various processes related to the physical space. The advanced information society is a society where economic growth and solution of social issues are expected.

[0084] In such an advanced information society, by analyzing communications (including acquisition and provision of information, as well as a method of expressing the information) or behaviors by an individual in various scenes of his or her daily life, and analyzing the big data including

the accumulated personal information, it is possible to provide information or services necessary for that individual, in a way of communication that seems most suitable for that individual, according to the scene.

[0085] Hereinafter, given the advanced information society where such a cyber physical system works, a description is given of specific aspects that enhance health and happiness of users, with support for daily life close to individual users as a theme.

[0086] FIG. **1** is a block diagram illustrating an example of an overall configuration of an information system according to an embodiment of the present disclosure. FIG. **1** illustrates a cyber space in an upper half and a physical space in a lower half. On the left side, resources related to company A that is a non-robot provider company are lined up. A company A server **101** is in the cyber space and a company A app running on a smartphone **100** is in the physical space. The company A server **101** operates as a pair with the company A app. On the right side resources related to company B that is a robot provider are lined up. A company B server **111** is in the cyber space, and a robot **110**, which is a movable device, and a company B app running on the smartphone **100** are in the physical space. The company B server **111** operates as a pair with the robot **110** and/or the company B app. In the middle of the physical space, there is a user who handles the company A app and the company B app installed on the smartphone **100**, and the robot **110**. The smartphone **100**, the robot **110**, the company A server **101**, and the company B server **111** are connected by a wide area communication network such as the Internet, so that they can communicate with each other.

[0087] As illustrated in FIG. **1**, the company A and the company B have contact points with users through their respective apps and robots. The company A only has the contact points via the app on the smartphone **100**, which is a form of a customer contact that is often seen today. On the other hand, the company B in FIG. **1** also has the contact points via the robot **110**, in addition to the contact points via the app on the smartphone **100**. Companies that have contact points with users (general consumers) via the robot **110**, which is an autonomous movable device, are unprecedented except for some toy manufacturers, and are expected to emerge in the future.

[0088] Note that here, although an illustration of a dog-shaped robot is used as an example of the robot **110**, the robot **110** may have a form based on any other living creatures including humans or may have an inorganic and non-living form. As far as the robot **110** has autonomous motor abilities (ability to change posture and ability to move, or the like) and/or an ability to operate (ability to move other objects, such as pressing a button or lifting an object) in the physical space, the robot is not limited in its form.

[0089] In an information system which is an embodiment of the present disclosure, the robot **110**, and home appliances and housing equipment operated by the robot **110**, or the like which are contact points of each customer are more highly linked than ever before. It can be said that it is an information system that expands the range of improvement in the quality of its own services and provides the users with a higher value while utilizing information and capabilities held by others. The cognitive and motor abilities of robots are evolving day by day. If such a versatile robot is realized, a mechanism is to be built that allows other companies to access unique abilities held by the robot. It is believed that doing so will be a basis for creating a wide variety of value collaborations for users, non-robot companies that provide services, and robot companies that provide robots.

[0090] FIG. **2** is a block diagram illustrating an example of a configuration of the information system according to the embodiment of the present disclosure. The smartphone **100** includes a communication unit **100***a*, a calculation unit **100***b*, a sensor **100***c*, a memory **100***d*, an operation unit **100***e*, and a video audio output unit **100***f*. The sensor **100***c* is a device that acquires video information, audio information, and/or surrounding environment information. The sensor **100***c* includes, for example, an image sensor and a microphone.

[0091] The video audio output unit **100***f* is a device that outputs video and audio. The video audio output unit **100***f* includes, for example, a display and a speaker. The operation unit **100***e* is a device that receives a button press or a touch operation from the user. The operation unit **100***e* includes, for example, a touch panel and a button. The calculation unit **100***b* is a device that performs information processing such as voice recognition, voice synthesis, information search, and information drawing, that is performed in the smartphone **100**. The calculation unit **100***b* is, for example, a central processing unit. The memory **100***d* holds data processed by the calculation unit **100***b*. The memory **100***d* is, for example, a semiconductor memory such as a flash memory. The communication unit **100***a* is a communication circuit that performs information communications with other computers on a network. When both the company A app and the company B app are installed, a program and necessary data are recorded in the memory **100***d* of the smartphone **100**, and that program is executed by the calculation unit **100***b*.

[0092] The company A server **101** operates in cooperation with the company A app installed on the smartphone **100**. The company A server **101** includes a communication unit **101***a*, a calculation unit **101***b*, and a memory **101***c*. The communication unit **101***a* is a communication circuit for performing information communications with the other computers on the network. The memory **101***c* records information related to the company A app and the user. The memory **101***c* is, for example, a mass storage such as a hard disk drive and a solid state drive. The calculation unit **101***b* performs processing of data exchanged with the outside. The calculation unit **101***b* is, for example, a processor such as a central processing unit.

[0093] The company B server **111** operates in cooperation with the company B app installed on the smartphone **100**. The company B server **111** includes a communication unit **111***a*, a calculation unit **111***b*, and a memory **111***c*. The communication unit **111***a* is a communication circuit for performing information communications with the other computers on the network. The memory **111***c* records information related to the company B app, the robot **110**, and the user. The memory **111***c* is, for example, a mass storage such as a hard disk drive and a solid-state drive. The calculation unit **111***b* performs processing of the data exchanged with the outside. The calculation unit **111***b* is, for example, a processor such as a central processing unit.

[0094] The robot **110** includes a communication unit **110***a*, a calculation unit **110***b*, a sensor **110***c*, a memory **110***d*, a movable unit **110***e*, and an audio output unit **110***f*. The sensor **110***c* is a device that acquires video information, audio information, and/or surrounding environment information.

The sensor **110***c* includes, for example, an image sensor and a microphone. The audio output unit **110***f* is, for example, a speaker and outputs audio. The robot **110** may include an operation unit (not illustrated) that receives a button press or a touch operation from the user. The movable unit **110***e* is a device that controls the posture of the robot **110** under the control of the calculation unit **110***b*, and moves the robot itself and provides dynamic actions on other objects. The movable unit **110***e* is, for example, an actuator such as a motor. The calculation unit **110***b* performs various calculation processes that are performed in the robot **110**. The calculation unit **110***b* is, for example, a processor such as a central processing unit. The memory **110***d* holds data processed by the calculation unit **110***b*. The memory **110***d* is, for example, a semiconductor memory such as a flash memory. The communication unit **110***a* is a communication circuit for performing information communications with the other computers on the network.

[0095] Note that although the company A server **101**, the smartphone **100**, the robot **110**, and the company B server **111** are connected via the wide area communication network so that they can communicate with each other, they may be connected by a dedicated communication network or Near Field Communication or the like, when low-latency communications, strong security, or local paring is requested, or the like.

(Providing Robot Capabilities in Health Management)

[0096] Hereinafter, a description is given of an embodiment in which health management of the user is carried out more effectively by using the familiar robot **110**.

[0097] FIG. **3** is a block diagram illustrating an example of an overall configuration of an information system according to an embodiment of the present disclosure. In this form, the company A, which is the non-robot company, is a health insurance company with which the user has a contract. To improve health of the user, the company A, which is an insurance company, has the user install a healthcare app, which is provided by the company A, on the smartphone **100** and use the app every day. The company A healthcare app continuously collects the biological activity information of the user (heartbeat, pulse, blood pressure, body temperature, body water content, breathing, sweating amount, activity amount (consumed calories), an intake amount (calorie intake), number of steps, posture, and a type of exercise, or the like) by a wearable sensor or the like on a daily basis. The company A healthcare app records the biological activity information in the memory **100***d* of the smartphone **100**, and, at the same time, periodically uploads the biological activity information to the company A server **101** ("(a) Biological activity information" in FIG. **3**).

[0098] The biological activity information collected in this manner is strictly managed by the company A server **101** as personal information of the user. The company A server **101** periodically analyzes health risk of the user based on the biological activity information of the user ("(b) Health risk analysis" in FIG. **3**). Furthermore, when it is determined that the amount of exercise taken by the user is insufficient, the company A server **101** transmits a nudge to the user in order to recommend the exercise. For example, a message "Let's exercise." causing a behavior change so that the user takes a desirable action is displayed via the company A app ("(c) Recommendation of exercise" in FIG. **3**). However, generally speaking, behavior change urged by this type of approach easily fails to give a sufficient motivation and often cannot solve the user's lack of exercise ("(d) No exercise" in FIG. **3**).

[0099] Conventional services provided in the information society until now (also called Society4.0 society) have been realized for a loop of (a) to (d), which are described here. With the conventional services, the cyber space and the physical space can cooperatively work to have a continuous contact with users and promote health improvement. In the conventional services, however, the biological activity information and the services are confined only in the services of the company A, and there is no cooperation with any entity other than the company A. The conventional services are in a silo state, so to speak. It seems that even though the company A slightly changes the expressions of the message displayed on the smartphone **100**, there are still many users who cannot easily change their behaviors. Therefore, the conventional services are not sufficient to be services that widely improve the health of users. In the present embodiment, the robot that is familiar to the user and has the autonomous motor abilities is used, and the autonomous motor abilities that are not held by the company A app but held by the robot are used to envision services for improving the health of the user. Forms to realize the services are described. Now, continuation of FIG. **3** is described.

[0100] If the company A server **101** determines from the periodically uploaded biological activity information that the user has not taken sufficient exercise even after the company A server **101** (one example of the second server) transmits the nudge to recommend exercise, the company A server **101** transmits request information for requesting the robot **110** to execute a task of encouraging the user to exercise (walk, for example) to the company B server **111** (one example of the first server) with which cooperation has been set in advance ("(e) Requesting exercise (walk)" in FIG. **3**). More specifically, the request information is transmitted after it is determined in the company B server **111** that the it is necessary to encourage the user to exercise. A description of the advance cooperation setting between the servers is given below.

[0101] When the company B server **111** that has received the request information confirms that the company A server **101** has the access right to the requested task, the company B server **111** decides to execute, suspend, or reject the request. Then, if the company B server **111** decides to execute the request, the company B server **111** outputs, to the robot **110** held by that user, instruction information that induces the user to exercise (walk) ("(f) Inducing and instructing to exercise (walk)" in FIG. **3**). This instruction information includes an instruction for the robot **110** to specifically present in a form understandable by the user how the robot behaves and what the robot requests of the user. For example, in the case of the dog-shaped robot, the instruction information for inducing to exercise that is received by the robot **110** includes an instruction for the robot **110** to directly tell the user "Let's go for a walk" or to bring a lead used for a walk and ask the user to go for a walk (showing its willingness to go for a walk), or the like. Contents of these specific instructions are included in the instruction information for inducing to exercise that is transmitted from the company B server **111** to the robot **110**, and the instruction is executed by the robot **110** ("(g) Inducing to exercise (walk)" in FIG. **3**).

[0102] The user who is thus asked by the dog-shaped robot to exercise (walk) together may be motivated more strongly than the nudge regarding the exercise received via the smartphone **100**. As a result, the user finally exercises (takes a walk) ("(h) Taking exercise (a walk)" in FIG. **3**). Here, a variety of methods for inducing by the robot **110** is possible and the foregoing is merely an example thereof. For example, if the robot **110** held by the user is too small to go for a walk together, or if the robot **110** imitates a living object (for example, a frog) that is unlikely to go for a walk, an inducing method for causing the frog-shaped robot to say "I want to see the nearby river", or the like, and guiding the user on the route thereto with the frog-shaped robot resting on the user's hand can be employed.

[0103] When the task requested by the instruction information ends, the robot **110** notifies the company B server **111** of information indicating that the user took exercise (a walk) and taken exercise amount information that includes a travel distance thereof or a walking speed. The company B server **111** that has received the taken exercise amount information notifies the company A server **101** of the taken exercise amount information (for example, a walking distance) as a final result for "(e) Requesting for exercise (walk)" ("(i) Notifying the amount of exercise (walking distance)" in FIG. **3**).

[0104] The company A server **101** records the taken exercise amount information ("(j) Recording the amount of exercise (walking distance)" in FIG. **3**), praises the user's exercise based on the taken exercise amount information, and presents to the user an evaluation message that evaluates the user's exercise, such as "You have achieved 5000 steps" or the like, through the company A app, in order to increase the user's motivation to exercise ("(k) Evaluation of exercise" in FIG. **3**).

[0105] Note that the company A app or the company A server **101** may feed back to the user the evaluation message like "(k) Evaluation of exercise" in FIG. **3**, without being based on the taken exercise amount information that is obtained from the company B server **111**. For example, the company A server **101** may display the evaluation message on the screen of the smartphone **100** by obtaining the biological activity information "(a) Biological activity information in FIG. **3**" from a step sensor worn by the user.

[0106] It was difficult to cause the behavior change that increases the amount of exercise of the user, only by messages such as video information and audio information on the smartphone **100**, which is the customer contact point of the company A. By the company A asking for a walk via the dog-shaped robot provided by the company B and the dog-shaped robot further walking together, it is possible to lower the user's psychological barrier to exercise (walk) and increase the amount of exercise of the user. Moreover, the user can expect that this will allow the user to better maintain the health.

[0107] When the robot **110** asks the user to change his/her behavior in this manner, and the robot **110** conveys its own intention or desire (wishing to go for a walk) to the user as if it were a living system, the user may want to let that living system (robot) do what it wants. This is because the user is requested to change his/her behavior based on the altruistic desire to meet the request of the robot, which is the living system with one will, rather than being requested to change his/her behavior solely based on the user's selfish desire to maintain the health. The service for maintaining the user's health disclosed here is an approach that combines the approach based on the selfish desire that can be independently realized by the company A with the altruistic desire that can only be realized through cooperation with the company B robot **110**.

[0108] It can also be said that this information system is an information system in which the apps or the robot **110**, which are respective customer contact points, are linked at a higher level, and improve the quality of their services while utilizing the information and the capabilities held by others, thereby providing the users with higher values. The cognitive and motor abilities of robots are evolving day by day. If such a versatile robot is realized, a mechanism is to be built that allows other companies to access unique abilities held by the robot. Doing so will be a basis for creating a wide variety of value collaborations for users, non-robot companies (company A) that provide services, and robot companies (company B) that provide robots **110**.

[0109] FIG. **4** is a flowchart illustrating an example of processing when the non-robot company (company A) cooperates with the robot **110**. For the company A app or the company A server **101** as illustrated in FIG. **3** to access the information and the capabilities of the robot **110** operated by the company B, it is necessary to appropriately set its access right in advance. FIG. **4** illustrates an example of a process to set the access right in advance.

[0110] Using the company B app installed in the smartphone **100**, the user sets the company B app to cooperate with the company A app. Specifically, based on the user's input, the company B app acquires a unique ID of the company A app used by the user (step S**1**). The company B app transmits a registration request for registering with the company B server **111** the acquired unique ID of the company A app together with a unique ID of the company B app (step S**2**). The company B server **111** that has received the registration request registers pair information of the company A app and the company B app. In this registration process, the access right is simultaneously registered, the access right indicating to what extent the company A is granted a right to access which of the unique capabilities of the robot **110** (step S**3**). Details of the access right is described below with reference to FIG. **5**. The pair information including the robot ID of the robot **110** and the unique ID of the company B app has been registered in advance in the company B server **111**. This registration is performed, for example, by the user inputting the unique ID of the robot **110** on an initial setting screen of the company B app.

[0111] The company B server **111** that has received the registration of the company A app notifies the company A server **101** of setting information on the access right for which the company A app is permitted (step S**4**). Specifically, the company B server **111** notifies the company A server **101** of the access right setting information, in addition to the pair information of the unique ID of the company A app and the unique ID of the company B app.

[0112] The company A server **101** registers with the memory **101***c* the pair information of the unique ID of the company A app and the unique ID of the company B app, and the access right setting information (step S**5**). When the company A app or the company A server **101** uses its unique capabilities for the robot **110** provided by the company B,

the information is used to identify a target robot **110** and to determine whether or not the unique capabilities can be used.

[0113] Here, it suffices if the access right to the robot **110** provided by the company B is correctly set for the company A app or the company A server **101**. The foregoing is merely an example thereof. Any registration method other than the above may be used.

[0114] FIG. **5** is a table illustrating an example of the access right setting information for the robot **110**. The company A can request various tasks from the robot **110** of the company B. Furthermore, the robot **110** is provided with various sensors **110***c* and the motor abilities (movable unit **110***e*). The access rights thereto from the company A are registered in the company B server **111** as well as the company A server **101** that is user side. Hereinafter, types of the access rights and permission levels thereof are described below. The setting of the access rights is performed by the user in step S**3** of FIG. **4**.

[0115] The types of the access rights are classified into "Task", "Sensor", and "Motor Ability". The "Task" is further classified into "Inducing to exercise" and "Conversation". The "Sensor" is further classified into "Camera image", "Ranging sensor", "Infrared sensor", "Microphone sound", "Tactile sensor", "Air temperature/humidity/barometric pressure sensor", and "Position sensor". The "Motor Ability" is further classified into "Ability to change facial expressions", "Ability to vocalize", "Ability to change a posture", and "Ability to move".

[0116] The "Inducing to exercise" that belongs to the "Task" is the access right indicating to what extent the non-robot company (company A) can request the robot **110** for the task of encouraging the user to exercise. The exercise mentioned here is, for example, walk, jogging, squats, push-ups, swimming, and yoga, or the like, and may be of any type. Here, for convenience of explanation, it is expressed that the access right is given when a request can be made, and that the access right is not given when a request cannot be made. The access right to "Inducing to exercise" is set in a stepwise manner as follows: from "0" without access right to "2" with the access right without limitation. For example, in response to a request for the "Inducing to exercise" task from the non-robot company (company A) whose permission level of this access right is "1", a robot operating company (company B) permits a request for light exercise that is less than or equal to predetermined exercise load, and controls the robot **110** and/or the company B server **111** within the permitted range.

[0117] 0: Not permitted

[0118] 1: Only light exercise permitted

[0119] 2: All permitted

[0120] The "Conversation" that also belongs to the "Task" is the access right that indicates to which extent the non-robot company (company A) can request for talking with the user via the robot **110**. The access rights to the "Conversation" can be set by selecting from the following two choices: "0" without access right or "1" with access right. For example, the robot operating company (company B) gives a permission to the request for the "Conversation" from the non-robot company (company A) whose permission level is "1", as having the access right. The robot operating company (company B) sets the microphone ("Microphone Sound" of the sensor **110***c*) and the speaker ("Ability to vocalize" of the Motor ability) to be accessible to the non-robot company (company A). Consequently, the non-robot company (company A) controls the robot **110** and/or the company B server **111** so that the user and the robot **110** can have a conversation. Therefore, if the access right to the "Conversation" task is also given, in conjunction therewith, the robot operating company (company B) also sets as if the non-robot company (company A) has the access right to the "Microphone sound" of the sensor **110***c* and the "Ability to vocalize" of the Motor ability.

[0121] 0: Not permitted

[0122] 1: Permitted

[0123] As described above, the task is used to determine whether or not to execute the request when the robot company receives the request for the robot **110** to execute some task, from the non-robot company. Therefore, the access right setting information in FIG. **5** is set for each non-robot company.

[0124] Note that in the present disclosure, a series of autonomous operations for the robot **110** to perform some encouragement or perform action on the user and/or a target object (for example, a TV remote controller, a lighting switch, or a door knob) in the real space, based on a request from the non-robot company is referred to as a task.

[0125] The "Camera image" is the access right to an image sensor (for example, an RGB image sensor) included in the robot (**110**). This may be an image sensor that is provided in a place that is apparently perceived as eyes of the robot. The access right to the "Camera image" can be set in a stepwise manner as follows: from "0" without access right to "3" with the access right given without limitation. For example, in response to the access request from the non-robot company (company A) whose permission level is "2", the robot operating company (company B) controls the robot **110** and/or the company B server **111** to return a low-quality moving image.

[0126] 0: Not permitted

[0127] 1: Only still images permitted

[0128] 2: Up to low-quality moving images permitted

[0129] 3: All permitted

[0130] The "Ranging sensor" is the access right to the sensor **110***c* (for example, a TOF sensor, a LIDAR, or the like) capable of measuring a distance to an object included in the robot **110**. The access right to the "Ranging sensor" can be set by selecting from the following two choices: "0" without access right or "1" with access right. For example, in response to the access request from the non-robot company (company A) whose permission level is "1", the robot operating company (company B) controls the robot **110** and/or the company B server **111** to return data (for example, a depth image) acquired by the ranging sensor.

[0131] 0: Not permitted

[0132] 1: Permitted

[0133] The "Infrared sensor" is the access right to a sensor included in the robot **110** and capable of measuring infrared rays. An infrared sensor is used to recognize a subject in the dark in a near-infrared region and to measure a temperature distribution of the subject in a far-infrared region. The access right to the "Infrared sensor" can be set by selecting from the following two choices: "0" without access right or "1" with access right. For example, in response to the access request from the non-robot company (company A) whose permission level is "1", the robot operating company (company B)

controls the robot **110** and/or the company B server **111** to return data (for example, a thermography image) acquired by the infrared sensor.

[0134] 0: Not permitted

[0135] 1: Permitted

[0136] The "Microphone sound" is the access right to the microphone included in the robot **110**. The access right to the "Microphone sound" can be set by selecting from the following two choices: "0" without access right or "1" with access right. For example, in response to the access request from the non-robot company (company A) whose permission level is "1", the robot operating company (company B) controls the robot **110** and/or the company B server **111** to return audio data acquired by the microphone.

[0137] 0: Not permitted.

[0138] 1: Permitted

[0139] The "Tactile sensor" is the access right to a sensor (for example, a MEMS silicon hair device sensor) included in the robot **110** and capable of measuring tactile sensation on a surface of the robot. The access right to the "Tactile sensor" can be set in a stepwise manner as follows: from "0" without access right to "2" with the access right given without limitation. For example, in response to a request from the non-robot company (company A) whose permission level is "1", the robot operating company (company B) controls the robot **110** and/or the company B server **111** to return only data on a part (for example, a head) of the robot, of data (for example, a pressure distribution image) acquired by the tactile sensor.

[0140] 0: Not permitted

[0141] 1: Only partially permitted

[0142] 2: All permitted

[0143] The "Air temperature/humidity/barometric pressure sensor" is the access right to an air temperature sensor, a humidity sensor, and a barometric pressure sensor included in the robot **110**. The access right to the "Air temperature/humidity/barometric pressure sensor" can be set by selecting from the following two choices: "0" without access right or "1" with access right. For example, in response to the access request from the non-robot company (company A) whose permission level is "1", the robot operating company (company B) controls the robot **110** and/or the company B server **111** to return data acquired by the air temperature sensor, the humidity sensor, and the barometric pressure sensor, respectively.

[0144] 0: Not permitted

[0145] 1: Permitted

[0146] The "Position sensor" is the access right to a sensor included in the robot **110** and measuring a current position of the robot. The access right to the "Position sensor" can be set by selecting from the following two choices: "0" without access right or "1" with access right. For example, in response to the access request from the non-robot company (company A) whose permission level is "1", the robot operating company (company B) controls the robot **110** and/or the company B server **111** to return data indicating information on the robot's current position that is acquired by the position sensor.

[0147] 0: Not permitted

[0148] 1: Permitted

[0149] The above is the explanation on the access rights to the sensors **110***c* included in the robot **110**. Then, the access rights to the motor abilities the robot is provided with are described below.

[0150] The "Ability to change facial expressions" is the access right to the ability of the robot **110** to change external characteristics of a face. When the robot **110** has a section that can be apparently perceived as a face, this may be an ability to move parts making up that face or an ability to change a part color. The access right to the "Ability to change facial expressions" can be set by selecting from the following two choices: "0" without access right or "1" with access right. For example, in response to the access request from the non-robot company (company A) whose permission level is "1", the robot operating company (company B) controls the robot **110** and/or the company B server **111** to change the facial expressions according to the request for changing the facial expressions.

[0151] 0: Not permitted

[0152] 1: Permitted

[0153] The "Ability to vocalize" is the access right to the audio output capability provided in the robot **110**. When the robot **110** has a section that can be apparently perceived as a mouth, this may be an ability to move parts making up the mouth or an ability to output sound from a periphery of the mouth. The access right to the "Ability to vocalize" can be set by selecting from the following two choices: "0" without access right or "1" with access right. For example, in response to the access request from the non-robot company (company A) whose permission level is "1", the robot operating company (company B) controls the robot **110** and/or the company B server **111** to output the sound from the periphery of the mouth according to audio information that should be vocalized.

[0154] 0: Not permitted

[0155] 1: Permitted

[0156] The "Ability to change posture" is the access right to an ability to change a posture that is included in the robot **110**. This may be an ability to change angles of a plurality of joint mechanism parts in the movable unit **110***e* of the robot **110**. However, this is not an ability to change a position of the robot **110** itself. The access right to the "Ability to change posture" can be set in a stepwise manner as follows: from "0" without access right to "2" with the access right given without limitation. For example, in response to the access request from the non-robot company (company A) whose permission level is "1", the robot operating company (company B) controls the robot **110** and/or the company B server **111** to move only the head according to the request.

[0157] 0: Not permitted

[0158] 1: Only head permitted

[0159] 2: All permitted

[0160] The "Ability to move" is the access right to the ability to move included in the robot **110**. This may be the ability to change the angles of the plurality of joint mechanism parts in the movable unit **110***e* of the robot **110**. However, the "Ability to move" is an ability to change the position of the robot **110** itself. The access right to the "ability to move" can be set in a stepwise manner as follows: from "0" without access right to "4" with the access right given without limitation. For example, in response to the access request from the non-robot company (company A) whose permission level is "1", the robot operating company (company B) controls the robot **110** and/or the company B server **111** to allow the robot to move at low speed in an area permitted by the user in the user's house. For example, in response to the access request from the non-robot company

(company A) whose permission level is "3", the robot operating company (company B) controls the robot **110** and/or the company B server **111** to allow the robot to move at high speed only inside and outside the area of house permitted by the user. Here, the area permitted by the user is one of conditions set by the user in advance. For example, it is possible to set in advance so that the robot cannot approach an area (for example, a bathroom) where the user's privacy may be violated.

[0161] 0: Not allowed

[0162] 1: Permitted to move at low speed only within the permitted house

[0163] 2: Permitted to move at low speed to inside/outside the permitted house

[0164] 3: Permitted to move at high speed to inside/outside the permitted house

[0165] 4: All permitted

[0166] FIG. **6** is a table illustrating an example of the level of urgency degree for determining whether or not the requested task can be executed. The description on FIG. **3** includes the scene in which the company A server **101** transmits the request information for requesting exercise to the company B server **111** ("(e) Requesting exercise (walk)"), and in response to this, the company B server **111** transmits to the robot **110** the instruction information requesting exercise ("(f) Inducing and instructing to exercise (walk)"). The request information transmitted in this scene includes urgency degree information. The urgency degree information is information indicating degree of urgency (urgency degree) for the user to exercise. The company B server **111** that receives the request information manages necessary urgency degree information. The necessary urgency degree information is information indicating urgency degree (necessary urgency degree) that becomes necessary for the robot **110** to execute the requested task.

[0167] The necessary urgency degree is used to cancel a request with a low urgency degree for the user, the request being made by other company (for example, the company A) via the robot **110**, such as while the user is concentrating on some specific work, or to suspend execution of the request till a timing when the encouragement is appropriate. The necessary urgency degree information is information held by the company B server **111** or the robot **110** and used by the company B server **111** or the robot **110**. The urgency degree indicated by the urgency degree information included in the request information that is requested to the robot **110** by another company (for example, the company A) is also set in accordance with the same criteria as those for the necessary urgency degree information. As illustrated in FIG. **6**, the necessary urgency degree may be set in stages such as high, medium, and low.

[0168] "High": When the necessary urgency degree is "high", a request that notifies the user of information with high urgency concerning life, health, danger, or risk of property loss is processed. Otherwise, the request is suspended or rejected.

[0169] "Medium": When the necessary urgency degree is "medium", a request that notifies the user of important information in the daily life is processed, in addition to the request whose necessary urgency degree is classified as "high". Otherwise, the request is suspended or rejected. The important information in the daily life includes, for example, information for notifying the user of a next schedule, and information for notifying the user of a state at risk of significant loss (for example, leaving a gas oven on).

[0170] "Low": When the necessary urgency degree is "low", all requests are executed.

[0171] As such, when the necessary urgency degree is set high, among requests received by the company B server **111** from the server of another company (the company A server **101**), only a request that is critical and urgent to the user is processed immediately. Any other requests are suspended or rejected. The urgency degree information included in the request information that is critical and urgent to the user is given by the other company (company A), which is the source, in accordance with the definition of the necessary urgency degree as described above.

[0172] More specifically, if the urgency degree information (high, medium, or low) included in the request information transmitted by the server of the other company (for example, the company A server **101**) is equal to or higher than the necessary urgency degree information (high, medium, or low) set for the company B (for example, the company B server **111**), a request indicated by that request information is processed immediately. Otherwise, the request is not executed immediately and suspended till the appropriate timing or rejected.

[0173] As noted above, in order to realize the scenario of providing the capabilities of the robot **110** in the health management as illustrated in FIG. **3**, a description has been given of the cooperation setting between the company A and the company B, the access rights to the robot capabilities of the company A, and the urgency degree of the requests. Hereinafter, an overall flow of processing for realizing this scenario by using them is described.

[0174] FIG. **7** is a flowchart illustrating an example of a process in which the non-robot company requests a task from the robot **110**. In particular, FIG. **7** illustrates a case where the request is immediately executed.

[0175] As also illustrated in FIG. **3**, the application of the insurance company A (the company A app) that is installed in the smartphone **100** continuously detects the biological activity information of the user and accumulates the detected biological activity information in the memory in the smartphone **100** (step S**11**). Furthermore, the company A app periodically uploads the accumulated biological activity information to the company A server **101** (step S**12**). The company A server **101** that has received the biological activity information determines a need to transmit a message (nudge) recommending the user to exercise, based on an insurance contract between the user and the company A (step S**13**). If it is determined that there is the need to transmit the nudge, the company A server **101** transmits the nudge (step S**14**). On the contrary, if it is determined that there is no need to transmit the message recommending exercise, the company A server **101** continues a process of accumulating the biological activity information of the user that is uploaded from the company A app.

[0176] In step S**15**, the smartphone **100** displays the message recommending exercise. This presents the message recommending exercise to the user.

[0177] In step S**16**, even after displaying the message recommending exercise, the company A app and/or the company A server **101** continuously detects the biological activity information of the user, calculates the amount of

exercise taken by the user based on the detected biological activity information, and evaluates the calculated amount of exercise.

[0178] The company A server **101** determines a need to encourage the user to exercise more strongly, based on the insurance contract between the user and the company A. Here, if a state is observed more than or equal to a predetermined number of times in which the amount of exercise taken by the user calculated in step S**16** is less than the target amount of exercise, the company A app and/or the company A server **101** determines that stronger encouragement is needed since the nudge did not improve the amount of exercise taken by the user. Here, it is assumed that the determination is made that the stronger encouragement is needed. On the contrary, if it is determined that the stronger encouragement is not needed, the company A server **101** continues the process of accumulating the biological activity information of the user that is uploaded from the company A app. Here, for example, if the state is not observed more than or equal to a predetermined number of times in which the amount of exercise taken by the user calculated in step S**16** is less than the target amount of exercise, the company A app and/or the company A server **101** determines that stronger engagement is not needed

[0179] The company A server **101** that determined in step S**17** that the stronger encouragement is needed transmits to the company B server **111** the request information requesting the robot **110** for the task of encouraging the user to exercise.

[0180] The request information includes the unique ID of the company A app of the user, the urgency degree information indicating urgency degree of the request, suspension period information indicating a suspension period till the request is executed, and content of the request. The content of the request indicates, for example, a task that is requested to the robot **110**. The company B server **111** that has received the request information can identify the unique ID of the company B app corresponding to the unique ID of the company A app, from the unique ID of the company A app included in the request information. Since the company B server **111** manages the robot ID of the robot **110** corresponding to the unique ID of the company B app, it is possible to uniquely identify the robot **110** that is to execute the task requested by the company A.

[0181] Furthermore, the request information includes the target amount of exercise needed by the user. The target amount of exercise is, for example, 5000 steps per day or 150 Kcal of calories burned in a day, or the like. In this example, the target amount of exercise is 5000 steps per day, and the current amount of exercise by user is 2000 steps per day. To urge the user to take a walk of 5000 steps per day, the company A server **101** transmits the request information to the company B server **111**. In addition, the urgency degree indicated by the urgency degree information included in this request information is "low".

[0182] In step S**18**, the company B server **111** that has received the request information determines whether or not response to the request is possible. The company B server **111** has set the necessary urgency degree indicated by the necessary urgency degree information to "low" before receiving this request information (step S**10**). Thus, the company B server **111** compares the urgency degree indicated by the urgency degree information included in the received request information with the necessary urgency degree indicated by the preset necessary urgency degree information to determine whether or not response to the request is possible. Here, since the urgency degree indicated by the urgency degree information included in the request information is "low", the necessary urgency degree indicated by the necessary urgency degree information is "low", and the urgency degree indicated by the urgency degree information is equal to or higher than the necessary urgency degree indicated by the necessary urgency degree information, the company B server **111** determines that the request indicated by this request information be immediately executed. Therefore, the company B server **111** transmits to the company A server **101** response possible information indicating that the request will be responded (step S**19**). The request information and the necessary urgency degree information are examples of the first information.

[0183] The company B server **111** that has transmitted the response possible information transmits to the robot **110** the instruction information instructing the robot **110** to take an inducing action to urge the user to exercise that is equal to or larger than the target amount of exercise (step S**20**). This inducing action is the action of the robot **110** such as telling the user "Let's go for a walk" or bringing the lead and asking for going for a walk, as described above. Depending on the appearance and motor abilities of the robot **110**, various forms of the inducing actions are used.

[0184] The instruction information may include validity period information indicating the period of validity. The period of validity is, for example, 10 minutes. If the robot **110** continues to ask the user to go for a walk for the period of validity based on the instruction information but the user does not respond, the robot **110** may automatically stop the inducing action. Furthermore, if the behavior change of the user does not succeed in this manner, the robot **110** may take the inducing action again after a certain period of time has elapsed, or while the user is relaxing. In addition, the period of validity of the inducing action in this case may be shorter than the period of validity of the last inducing action that failed. The reason for setting the period of validity shorter is that a relationship between the user and the robot may deteriorate if the failed inducing action is repeated in the same manner.

[0185] The robot **110** that has received the instruction information from the company B server **111** takes the inducing action to take the user out for exercise (taking a walk of 5000 steps per day) according to the instruction information (step S**21**). In this example, since the robot **110** is the dog-shaped robot, it takes the inducing action of wagging its tail while barking "bow-wow". This inducing action can remind the user of walk. Besides, the robot **110** may repeat the inducing action of talking to the user in a language understandable by the user, such as "Let's take a walk" or "I want to go for a walk" or the like, and/or the inducing action of showing the intention of going for a walk by bringing the lead used for the walk, during the period of validity.

[0186] If the company A server **101** has the access right to the sensor **110***c* or the motor abilities of the robot **110** and seeks direct access to the motor abilities, the company A server **101** analyzes a surrounding situation of the robot **110**, and, based on a result of the analysis, may transmit a command to control the facial expressions, the vocalization, the posture, and the movement of the robot **110** to the robot **110** directly or via the company B server **111**. Consequently, the company A server **101** can directly control the robot **110**.

[0187] In response to these inducing actions from the robot **110**, the user makes a decision to take a walk and takes exercise (a walk) with the robot (step S**22**). According to the instruction information from the company B server **111** that instructs the walk of 5000 steps, the robot **110** proposes a walking course to the user, and/or may lead the walking by itself, so that the number of steps of the walk will be 5000 steps.

[0188] In a case where the robot **110** does not have the ability to walk with the user, such as being small or having no function to walk, the robot **110** may propose the walking course to the user, so that the number of steps of the walk will be 5000 steps. In this case, the robot **110** may take the inducing action to encourage the user so that the use achieves the target amount of exercise. For example, the robot **110** may speak such as "Let's stop by the nearby supermarket newly opened " or "If you climb the hill tonight, you may be able to see a shooting star". This adjusts the number of steps of the walk (amount of exercise).

[0189] In this manner, if the robot **110** senses by the camera image or the position sensor or the like that the user has returned home after successfully taking exercise (a walk), the robot **110** transmits to the company B server **111** an end notice indicating that the exercise (walk) with the user has ended and the taken exercise amount information indicating the amount of exercise taken in the exercise (step S**23**). The taken exercise amount information includes information indicating, for example, the number of steps, the walking course, and a pace of the walk.

[0190] The company B server **111** transmits the end notice of the request and the taken exercise amount information to the company A server **101** (step S**24**). The company A server **101** that has received the end notice and the taken exercise amount information records, in the memory **101***c*, information indicating the requested exercise was taken and the taken exercise amount information, as an implementation record (step S**25**).

[0191] If the company A server **101** determines that the amount of taken exercise indicated by the taken exercise amount information is equal to or larger than the target amount of exercise indicated by target exercise amount information, the company A server **101** transmits to the smartphone **100** the evaluation message indicating that the user has achieved the target amount of exercise (step S**26**). The smartphone **100** that has received the evaluation message displays the evaluation message indicating that the target amount of exercise has been achieved, through the company A app (step S**27**). As a result, the user can obtain a certain sense of achievement and reduce the sense of resistance to exercise (walk). Note that if the amount of taken exercise is less than the target amount of exercise, the company A server **101** may transmit an evaluation message indicating accordingly to the smartphone **100**.

[0192] Here, although the case where the request inducing to exercise is immediately executed is described, there is a case where the user cannot immediately respond to encouragement from the robot **110** during a business meeting or the like.

[0193] FIG. **8** is a flowchart illustrating an example of a process in which the non-robot company requests a task from the robot **110**. In particular, FIG. **8** illustrates a case where a request is not executed immediately. FIG. **8** differs from FIG. **7** in the necessary urgency degree information when the company B server **111** receives the request information. In FIG. **7**, the necessary urgency degree indicated by the necessary urgency degree information is "low" where any request is immediately executed by the robot **110**. On the other hand, in FIG. **8**, the necessary urgency degree indicated by the necessary urgency degree information is "medium". Unless the urgency degree indicated by the urgency degree information included in the request information is "medium" or "high", the request is not immediately executed. In this case, the request is suspended till an appropriate timing or rejected. FIG. **8** exemplarily illustrates a case where the request is suspended till the appropriate timing.

[0194] The process in which the company A continuously detects the biological activity information of the user using the company A app and the company A server **101** and transmits to the company B server **111** the request information with "low" urgency degree requesting the user to exercise (equivalent to 5000 steps in a walk) is same as that of FIG. **7** and thus a description thereof is omitted. A difference lies before the process (step S**17**) in which this request information is transmitted.

[0195] In step S**801**, the robot **110** determines on a statement of the user who has an intention of not communicating with the robot **110** or the user's situation. In step S**802**, the robot **110** updates the necessary urgency degree to "medium" (one example of a predetermined level) based on a result of the determination on the statement or the situation.

[0196] For example, when the user makes a statement to the robot **110** with the intention of not communicating with the robot **110**, such as "Keep quiet" or "Don't talk to me", the robot **110** only has to change the necessary urgency degree from "low" to "medium". Alternatively, when the robot **110** has recognized from sensing data of the sensor **110***c* that the user is talking or driving a car, the robot **110** may change the necessary urgency degree from "low" to "medium". The robot **110** that has changed the necessary urgency degree to "medium" transmits an update request for updating the necessary urgency degree to "medium" to the company B server **111**. The company B server **111** that has received this update request updates the necessary urgency degree from "low" to "medium" (step S**802**).

[0197] The company B server **111** that has received the request information from the company A server **101** determines whether or not response is possible, based on the urgency degree and the necessary urgency degree included in the request information (step S**18**). Here, since the "low" urgency degree is lower than the "medium" necessary urgency degree, the company B server **111** determines that the request cannot be executed immediately. The company B server **111** that has determined that the request cannot be executed immediately transmits to the company A server **101** suspension information indicating that the request has been suspended (step S**803**).

[0198] Subsequently, the robot **110** continuously performs a process to determine whether or not it is necessary to change the necessary urgency degree, based on the user's statement and the sensing data from the sensor **110***c* (step S**804**). When the user expressly makes a statement that lowers the necessary urgency degree, when the user makes a statement including a topic which is not urgent, or when it is determined that the user takes on behavior with low urgency, the robot **110** may set the necessary urgency degree

to "low". The behavior with low urgency is, for example, behavior such as watching TV, operating a smartphone, or the like.

[0199] When the necessary urgency degree is updated from "medium" to "low", the robot **110** transmits to the company B server **111** the update request for updating the necessary urgency degree to "low" (step S**805**).

[0200] The company B server **111** hat has received the update request changes the necessary urgency degree from "medium" to "low". Next, the company B server **111** determines again whether or not response to the request that is being suspended is possible (step S**806**). Here, since the urgency degree indicated by the urgency degree information included in the request information transmitted from the company A server **101** in step S**803** is "low", the necessary urgency degree indicated by the current necessary urgency degree information is "low", and the urgency degree is equal to or higher than the necessary urgency degree, the company B server **111** transmits the response possible information to the company A server **101** (step S**807**).

[0201] Since subsequent processing is the same as that of FIG. **7**, a description thereof is omitted.

[0202] As described with reference to FIG. **7** and FIG. **8**, the mechanism of the company B server **111** is summarized as follows. The company B server **111** causes the robot **110** of the company B, which is familiar to the user, to execute a request that needs the motor abilities of the sensor **110***c* or the robot **110** that are not held by the company A (company A app). The company B server **111** performs the cooperation setting between the company A and the company B for each user. Based on the user's advance input, the company B server **111** registers in advance the access right setting information that defines to what extent the respective capabilities of the robot **110** of the company B are to be used by the company A. When the user is in the situation in which the user cannot care about the robot **110**, the company B server **111** suspends or rejects a request with a low urgency degree. The company B server **111** re-executes the suspended request at an appropriate timing, in response to a request from the user or any change in the user's situation.

[0203] FIG. **9** is a flowchart illustrating an example of processing of the company B server **111**. In the processing of FIG. **9**, the company B server **111** determines whether or not the non-robot company (company A) has the access right necessary for carrying out a requested task, whether or not there is urgency to immediately execute the task requested for the user, and whether or not the request execution of which is suspended exceeds the suspension period, and responds to the request of the non-robot company (company A) based on the determination result. Specifically, the processing is as follows.

[0204] In step S**101**, the company B server **111** receives from the company A server **101** the request information requesting the robot **110** for the task of encouraging the user to exercise.

[0205] In step S**102**, the company B server **111** confirms the access right of the company A to the requested task. First, the company B server **111** determines whether or not the pair information in which the unique ID of the company A app that is included in the request information is associated with the unique ID of the company B app has been pre-registered in the memory **111***c*. Then, when the company B server **111** determines that the pair information has been pre-registered, the company B server **111** confirms based on the access right setting information illustrated in FIG. **5** whether or not the company A holds the access right to the task requested by the request information. Here, since the permission level of the access right of the company A for the task of "Inducing to exercise" illustrated in FIG. **5** is set to "1" or "2", it is determined that the company A has the access right to the requested task. Note that if the permission level of the access right of the company A to the task of "Inducing to exercise" is "0", it is determined that the company A has no access right.

[0206] If it is determined that the company A has no access right (NO in step S**103**), the company B server **111** transmits to the company A server **101** a message indicating that the company A has no access right to execute the requested task (step S**104**), and the processing ends.

[0207] On the other hand, if it is determined that the company A has the access right (YES in step S**103**), the company B server **111** compares the urgency degree indicated by the urgency degree information included in the request information that is received in step S**101** with the corresponding necessary urgency degree of the user currently set, and determines whether or not to execute the request indicated by the request information immediately (step S**105**).

[0208] If the urgency degree is less than the necessary urgency degree (NO in step S**105**), the company B server **111** determines whether or not time elapsed since receipt of the requested information is within the suspension period (step S**109**).

[0209] The suspension period is time information indicating how long the request execution of which is suspended is to be suspended. When the elapsed time from receipt of the request information exceeds the suspension period (NO in step S**109**), the company B server **111** rejects the request indicated by that request information (step S**111**). The company B server **111** that has rejected the request transmits to the company A server **101** that made the request, a message that the request has been rejected as the suspension period was exceeded, and the processing ends.

[0210] This prevents a large number of accumulated requests with the "low" urgency degree from being executed all at once at the moment when the necessary urgency degree is updated to "low". Furthermore, it prevents execution of requests which is currently meaningless because a long time has passed since the requests were received. Rejection of such requests is needed to maintain the effect of encouragement to the user by the robot **110**.

[0211] On the other hand, when the elapsed time from receipt of the request information is within the suspension period (YES in step S**109**), the company B server **111** acquires state data of the user via the robot **110** and re-evaluates the current necessary urgency degree via the robot **110**, based on the acquired state data (step S**110**). Alternatively, the robot **110** may acquire the state data of the user, set the current necessary urgency degree by itself based on the acquired state data, and notify the company B server **111**. When the processing of step S**110** ends, the processing returns to step S**105**. As a result, the loop processing illustrated in steps S**105**, S**109**, and S**110** is performed. With this loop processing, only requests with the urgency degree that is equal to or higher than the necessary urgency degree that becomes necessary for encouraging the user are executed as needed, and execution of requests that do not have the urgency degree that is equal to or higher than the

necessary urgency degree that becomes necessary for encouraging the user continues to be suspended during the suspension period. The state data is data that dynamically varies in relation to the user's state sensed by the robot **110**. Specifically, as illustrated in FIG. **9** below, the state data includes the necessary urgency degree information that is set based on the sensing data by the sensor **110***c* of the robot **110**.

[0212] When the urgency degree indicated by the urgency degree information included in the request from the company A server **101** is equal to or higher than the necessary urgency degree managed by the company B server **111** or the robot **110** (YES in step S**105**), the processing proceeds to step S**106**.

[0213] In step S**106**, when the user is in a state in which the user may be encouraged to exercise, the company B server **111** transmits the instruction information instructing the robot **110** to execute the task requested from the company A server **101**. The robot **110** that has received the instruction information executes the task according to the instruction information. As a result, the robot **110** takes the inducing action to take the user out for a walk. The user who has decided to take a walk by this inducing action takes a walk with the robot **110**. The robot **110** that has returned from the walk transmits to the company B server **111** a task execution result, the end notice informing the end of the walk, and the taken exercise amount information in the walk. As a result, the company B server **111** receives the end notice and the taken exercise amount information (step S**107**).

[0214] In step S**108**, the company B server **111** transmits the received end notice and taken exercise amount information to the company A server **101**.

[0215] Note that if the company A server **101** has the access rights to the sensor **110***c*, the ability to change facial expressions, the ability to vocalize, the ability to change posture, and/or the ability to move, which are the motor abilities, for the robot **110**, the company A server may directly control the facial expressions, the voice utterance, the posture, and/or the movement of the robot **110**, according to the surrounding conditions of the robot **110** via the company B server **111**. Also in this case, the robot **110** instructed by the company B server **111** to execute the task may transmit the task execution result to the company B server **111**. That is, although the company A server **101** remotely controls the robot **110**, it is the company B server **111** that directly controls the robot **110**, and the relationship between the robot **110** and the company B server **111** is the same as the aspect described above.

[0216] It is expected that remote control of the robot **110** by the company A server **101** will be realized in the future by establishing high-speed and low-latency wireless communication infrastructure called "5G" or "Beyond 5G", or the like. The company B server **111** that has received the task execution result transmits the execution result to the company A server **101**, which is the request source of the task, and the processing ends.

[0217] FIG. **10** is a table illustrating an example of setting of the necessary urgency degree. FIG. **10** illustrates a transition in the user's states from 8'oclock in the morning to 8'oclock in the evening. Although in the following description, a description is given assuming that the robot **110** sets the necessary urgency degree, this is an example, and the company B server **111** may set. In this case, the company B server **111** may set the necessary urgency degree based on the sensing data acquired via the robot **110**.

[0218] The robot **110** continuously senses the user's state, detects the user's state from the sensing result, as needed, and updates the necessary urgency degree appropriately based on the detection result.

[0219] During a time zone from 8:00 to 10:00, the user is talking with another person face-to-face. Using the sensor **110***c* such as the camera and the microphone or the like, the robot **110** determines that the user is talking with the other person. A neural network has been developed that determines or explains human behavior and states from still images, moving images, or audio. Therefore, using an image recognition technique or an audio recognition technique based on such a neural network, the robot **110** may detect the user's state. After determining that the user's state is talking, the robot **110** sets the necessary urgency degree to "medium". As a result, unless a request has the "medium" or higher urgency degree, the request will no longer be executed. Then, the robot **110** shares the set necessary urgency degree with the company B server **111**.

[0220] Further in this determination, the robot **110** may also perform a sentiment analysis of the user from conversation content and voice tone, or the like, included in the facial expressions and gestures acquired from the camera and/or audio information acquired from the microphone. Here, results of the sentiment analysis are classified to, for example, "positive", "neutral", and "negative". In the case of conversations for which the result of the sentiment analysis is "positive" or "neutral", it is highly likely that the user will tolerate interruptions by the robot **110** to the conversation to execute the task. In this case, the robot **110** may lower the necessary urgency degree set above. In addition, in the case of the conversation for which the result of the sentiment analysis is "negative", it is highly likely that the user will not tolerate the interruptions to the conversation. Thus, the robot **110** may maintain or increase the necessary urgency degree set above. When the necessary urgency degree is changed, the robot **110** shares the changed necessary urgency degree with the company B server **111**.

[0221] Adding the sentiment analysis of the user to the determination on the user's state in this manner enables the robot **110** to process the task in a more appropriate timing for the user.

[0222] Here, although the results of the sentiment analysis are classified to three categories, the present disclosure is not limited thereto. The results of the sentiment analysis may be classified to more categories such as "delight, anger, sorrow, and pleasure" or fewer categories such as two categories of "positive" and "negative". In addition, the robot **110** may estimate a degree of user's stress and adjust the necessary urgency degree according to a numerical range of the estimated degree of stress.

[0223] During the time zone from 10:00 to 12:00, the user is working (working) at a computer. Using the sensor **110***c* such as the camera, the microphone, or the like, the robot **110** detects that the user is operating the computer. After determining that the user is working at the computer, the robot **110** maintains the necessary urgency degree at "medium". In this case, unless a request has the "medium" or higher urgency degree, the request will not be executed. Then, the robot **110** shares the set necessary urgency degree with the company B server **111**.

[0224] During the time zone from 12:00 to 13:00, the user is sitting on a chair and having a meal. Using the sensor **110***c* such as the camera, the microphone, or the like, the robot **110** detects that the user is having a meal. After determining that the user is having a meal, the robot **110** sets the necessary urgency degree to "low" which is the lowest. Then, the robot **110** shares the set necessary urgency degree with the company B server **111**.

[0225] During the time zone of 13:00 to 15:00, the user is on the phone or in a meeting. Using the sensor **110***c* such as the camera, the microphone, or the like, the robot **110** detects that the user is talking over a mobile phone (on the phone) or talking over the computer (in the meeting). After determining that the user is on the phone or in the meeting, the robot **110** sets the necessary urgency degree to "medium". In this case, unless a request has the "medium" or higher urgency degree, the request will not be executed. Then, the robot **110** shares the set necessary urgency degree with the company B server **111**.

[0226] During the time zone from 15:00 to 16:00, the user is exercising. Using the sensor **110***c* such as the camera, the microphone, or the like, the robot **110** detects that the user is exercising. After determining that the user is exercising, the robot **110** maintains the necessary urgency degree at "medium".

[0227] Further in this determination, the robot may measure a periodic change in the user's skin color based on the image acquired from the camera or may measure the user's heart rate by using a smart watch, or the like. When the heart rate measured here is lower than a predetermined value, it is highly likely that the user will tolerate the interruptions by the robot **110** to the exercise to execute the task. In this case, the robot **110** may lower the necessary urgency degree. On the other hand, when the heart rate is higher than the predetermined value, it is highly likely that the user will not tolerate the interruptions by the robot **110** to exercise to execute the task. Therefore, the robot **110** may maintain the necessary urgency degree or increase the necessary urgency degree. When the necessary urgency degree is changed, the robot **110** shares the changed necessary urgency degree with the company B server **111**.

[0228] When it is determined that the user's state is exercising in this manner, adding the user's heart rate enables the robot **110** to process the task in a more appropriate timing for the user.

[0229] During the time zone of 16:00 to 20:00, the user is lying down and relaxing. Using the sensor **110***c* such as the camera, the microphone, or the like, the robot **110** detects that the user is in a relaxing state. After determining that the user is in the relaxing state, the robot **110** sets the necessary urgency degree to "low" which is the lowest. Then, the robot **110** shares the necessary urgency degree with the company B server **111**.

[0230] In this manner, the user's state is changing from moment to moment. Utilizing the sensor **110***c*, the robot **110** senses the user's state and determines the user's state, as needed. Furthermore, the robot **110** updates the necessary urgency degree based on the determination result. When updating the necessary urgency degree, the robot **110** notifies the company B server **111** of the updated necessary urgency degree and shares the most recent necessary urgency degree with the company B server **111**. In this manner, the necessary urgency degree varies depending on the user's state, as needed.

[0231] As such, according to the present embodiment, when determining that it is necessary to encourage the user to exercise, the company A server **101** can encourage the user to exercise through the robot **110** managed by the company B server **111**.

[0232] Consequently, even though the company A server **101** itself does not control the robot **110**, the company A server **101** can cause the robot **110** to take the action to encourage the user to exercise. Therefore, it is possible to give the user the stronger motivation to exercise than a case where the video audio output unit **100***f* of the user's smartphone **100** merely displays a message urging the user to exercise.

[0233] Note that the present embodiment can be employed in the following modification examples.

[0234] (1) In step **S801** of FIG. **8**, the robot **110** may ask the user a question, such as "May I talk to you now?" or "May I bother you a bit?" to confirm he user's current necessary urgency degree, and cause the user to answer. The robot **110** directly asks the user of the questions as described above if the number of requests that have not been executed at a predetermined timing or yet, and/or when the urgency degree thereof meets predetermined conditions, or the like. With these questions, the robot **110** may acquire information for setting the necessary urgency degree, from content of the user's answer. In the case of this method, since the robot **110** can directly confirm with the user about the necessary urgency degree, the robot **110** can set and update the necessary urgency degree information as recognized by the user.

[0235] Here, when the user gives a positive answer such as "OK" to the above question, the robot **110** may set the necessary urgency degree to the low level such as "low". In addition, when the user answers such as "Please come later" or when no answer can be obtained, the robot **110** may set the necessary urgency degree to the high level such as "medium" or "high", assuming that it is not the right time to encourage the user.

[0236] (2) The smartphone **100** is an example of an information terminal, and in the present disclosure, the information terminal is not limited to the smartphone **100**. The information terminal may be a tablet computer and a portable information terminal may be employed.

[0237] According to the present disclosure, it is possible to safely realize the demand or direct control of sensors or motor abilities held by devices of other companies. This makes it possible to perform some kind of action from cyber space to physical space through software by fusing the cyber space and the physical space, from the conventional distribution of information only in the cyber space, which can thus be expected as a basic technique for a wide variety of industrial uses.

What is claimed is:

1. A method for a first server that communicates with a robot and controls the robot, comprising:

acquiring, from a second server, request information that indicates a request for an action of the robot and that includes urgency degree information indicating a first urgency degree for the user to exercise, wherein the second server determines whether or not it is required to encourage a user to exercise based on biological activity information acquired from an information terminal of the user, the biological activity information indicating biological activity of the user, and wherein

the request information is transmitted from the second server after the second server determines that it is required to encourage the user to exercise;

if it is confirmed at the first server that the second server has an access right to make the robot perform the request indicated by the request information, making a decision for one of an action group comprising at least two of execution, suspension, or rejection of the request based on i) the urgency degree information and ii) necessary urgency degree information that is managed at the first server, wherein the necessary urgency degree information indicates a second urgency degree that is required for the robot to execute the request; and

after the decision to execute the request is made, transmitting, to the robot, instruction information that causes the robot to take an action for encouraging the user to exercise.

2. The method according to claim **1**, wherein

the decision to execute the request is made, if the first urgency degree indicated by the urgency degree information is equal to or higher than the second urgency degree indicated by the necessary urgency degree information.

3. The method according to claim **1**, wherein

a decision to suspend or reject the request is made, if the first urgency degree indicated by the urgency degree information is less than the second urgency degree indicated by the necessary urgency degree information.

4. The method according to claim **1**, wherein

the request information further includes suspension period information indicating a suspension period during which a decision on the request indicated by the request information can be suspended, and

a decision to reject the request is made, if, during the suspension period, the first urgency degree indicated by the urgency degree information is not equal to or higher than the second urgency degree indicated by the necessary urgency degree information.

5. The method according to claim **1**, wherein

the request information further includes suspension period information indicating a suspension period during which a decision on the request indicated by the request information can be suspended, and

the decision to execute the request is made, if, during the suspension period, the first urgency degree indicated by the urgency degree information is equal to or higher than the second urgency degree indicated by the necessary urgency degree information.

6. The method according to claim **1**, wherein

the second urgency degree is determined based on information indicating a statement made by the user toward the robot, the statement being obtained based on a sensing result of a sensor provided on the robot, and

if the statement includes a word with an intention of not communicating with the robot, the second urgency degree is increased to a predetermined level.

7. The method according to claim **1**, wherein

the second urgency degree is determined based on information indicating an answer made by the user to a question, the information being acquired by the robot, and

the question is outputted from a speaker of the robot and is a question to confirm with the user the second urgency degree.

8. The method according to claim **1**, wherein

the second urgency degree is determined based on behavior of the user that is obtained by analyzing an image of the user acquired from the sensor provided on the robot, and

when the behavior of the user is being on the phone or operating a personal computer, the second urgency degree is increased to a predetermined level.

9. The method according to claim **1**, wherein

the instruction information further includes validity period information indicating a period of validity of the instruction information.

10. The method according to claim **9**, wherein

if time elapsed from the determined timing exceeds the period of validity, the robot cancels the instruction information without encouraging the user to exercise.

11. The method according to claim **1**, further comprising

transmitting, to the second server, taken exercise amount information indicating an amount of exercise taken by the user, after obtaining, from the robot, information indicating that the robot has taken the action indicated in the instruction information to encourage the user to exercise.

12. The method according to claim **1**, wherein

the first server is managed by a first operator that manages the robot,

the second server is managed by a second operator that manages the biological activity information acquired from the information terminal of the user, and

the second operator is different from the first operator.

13. A method for a second server that communicates with a first server associated with a robot and communicates with an information terminal of a user, the method comprising:

acquiring biological activity information indicating biological activity of the user from the information terminal of the user;

based on the biological activity information, determining whether or not it is required to encourage the user to exercise; and

transmitting, to the first server, request information that indicates a request for an action of the robot and that includes urgency degree information indicating a first urgency degree for the user to exercise, after it is determined at the second server that it is required to encourage the user to exercise, wherein if the first server confirms that the second server has an access right to make the robot perform the request by the request information, a decision for one of an action group comprising at least two of execution, suspension, or rejection of the request is made based on i) the urgency degree information and ii) necessary urgency degree information that is managed by the first server, the necessary urgency degree information indicating a second urgency degree that is required for the robot to execute the request, and wherein instruction information that causes the robot to take an action for encouraging the user to exercise is transmitted from the first server to the robot after the decision to execute the request is made at the first server.

14. The method according to claim **13**, wherein

the request information includes exercise amount information indicating an amount of exercise required for the user, the amount being calculated based on the biological activity information,

the method comprising:

after the user exercises as a result of the robot encouraging the user to exercise based on the request information, acquiring taken exercise amount information indicating the amount of exercise that the user has taken;

creating an evaluation message that evaluates the exercise of the user based on the exercise amount information and the taken exercise amount information, and

transmitting the evaluation message to the information terminal of the user.

15. The method according to claim **14**, wherein

if it is determined based on the exercise amount information and the taken exercise amount information that the amount of exercise taken by the user is equal to or larger than an amount of exercise targeted by the user, a message that user has achieved the target amount of exercise is created, as the evaluation message.

16. A method for a first server that communicates with a robot and controls the robot, comprising:

acquiring, from a second server, request information indicating a request for an action of the robot, wherein the second sever determines whether or not it is required to encourage a user to exercise based on biological activity information acquired from an information terminal of the user, the biological activity information indicating biological activity of the user, and wherein the request information is transmitted from the second server after the second server determines that it is required to encourage the user to exercise;

acquiring, from the robot, state data that is detected by the robot and that dynamically changes in relation to a state of the user, and

transmitting to the robot, instruction information for causing the robot to take an action for encouraging the user to exercise in response to the request information, after it is determined at the first server that the user is in a state in which the user can be encouraged to exercise based on the request information and the dynamic changes in the state data.

17. The method according to claim **16**, wherein

the request information further includes suspension period information indicating a suspension period during which a determination on the instruction information in response to the request information can be suspended, and

a decision to transmit the instruction information is made, when the user is in the state in which the user can be encouraged to exercise in the suspension period.

18. The method according to claim **17**, wherein

a decision not to transmit the instruction information is made, if the user is not in the state in which the user may be encouraged to exercise in the suspension period.

19. The method according to claim **16**, wherein

the request information includes urgency degree information that indicates a first urgency degree for the user to exercise, and

the state data includes necessary urgency degree information i) that depends on the dynamic changes in the state data acquired from the robot and ii) that indicates a second urgency degree that is required for the robot to execute the request.

20. The method according to claim **19**, wherein

it is determined whether or not the user is in the state in which the user can be encouraged to exercise, based on the urgency degree information and the necessary urgency degree information.

21. The method according to claim **19**, wherein

a decision to transmit the instruction information is made, when the first urgency degree indicated by the urgency degree information is equal to or higher than the second urgency degree indicated by the necessary urgency degree information.

22. The method according to claim **21**, wherein

a decision to suspend the transmission of the instruction information is made, when the first urgency degree indicated by the urgency degree information is less than the second urgency degree indicated by the necessary urgency degree information.

23. The method according to claim **16**, further comprising:

transmitting the instruction information to the robot, if it is confirmed that the second server has the access right to make the robot perform the request by the request information.

24. The method according to claim **23**, wherein

the first server registers registration information indicating whether or not the second server has the access right, and

the first server confirms based on the registration information that the second server has the access right.

25. A method for a second server that communicates with a first server associated with a robot and communicates with an information terminal of a user, the method comprising:

acquiring biological activity information indicating biological activity of the user from the information terminal of the user;

based on the biological activity information, determining whether or not it is required to encourage the user to exercise; and

transmitting, to the first server, request information indicating a request for an action of the robot after it is determined at the second server that it is required to encourage the user to exercise, wherein, at the first server, state data that is detected by the robot and that dynamically changes in relation to a state of the user is acquired from the robot, and wherein instruction information that causes the robot to take an action for encouraging the user to exercise is transmitted from the first server to the robot in response to the request information after it is determined at the first server based on the request information and the dynamic changes in the state data that the state of the user is a state in which the user can be encouraged to exercise.

26. The method according to claim **25**, wherein

the request information includes exercise amount information indicating an amount of exercise required for the user, the amount being calculated based on the biological activity information,

the method comprising:

after the user exercises as a result of the robot encouraging the user to exercise based on the request information, acquiring taken exercise amount information indicating the amount of exercise that the user has taken;

creating an evaluation message that evaluates the exercise of the user based on the exercise amount information and the taken exercise amount information, and

transmitting the evaluation message to the information terminal of the user.

27. The method according to claim **26**, wherein

if it is determined based on the exercise amount information and the taken exercise amount information that the amount of exercise taken by the user is equal to or larger than an amount of exercise targeted by the user, a message that user has achieved the target amount of exercise is created, as the evaluation message.

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