

DESCRIPTION

TITLE OF THE INVENTION: INFORMATION PROVISION DEVICE

TECHNICAL FIELD

[0001]

The present invention relates to an information provision device, an information provision system, an information provision method, and an information provision program that provide information for improving a blood glucose level.

BACKGROUND ART

[0002]

It is known that when a blood glucose level increases, the risk of diabetes increases, glucose in the blood enters endothelial cells in the wall, and active oxygen generated there damages blood vessels, thereby increasing the risk of many diseases. The diagnosis of diabetes is performed by combining the following numerical values.

(1) The blood glucose level in the morning fasting: 126 mg/dL or more

(2) Sugar tolerance test (75 g oral glucose tolerance test (OGTT)) 2 hour value:
200 mg/dL or more

(3) Blood glucose level at any time: 200 mg/dL or more

(4) Hemoglobin A1c (HbA1c): 6.5% or more

[0003]

Even if a diagnosis of diabetes is not made based on these numerical values, a determination is made as potential diabetics when a fasting blood glucose level is 110 mg/dL or more, and a high risk of diabetes is high. Therefore, it is desirable to lower the blood glucose level. The increase in a blood glucose level has a large relationship with meal, and Non-Patent Document 1 describes that the increase in a blood glucose level can be controlled by exercise.

[0004]

Further, in Patent Document 1, a spectroscope, an accelerometer, a heart rate sensor, a blood pressure sensor, a blood glucose level sensor, a perspiration sensor, and a skin conduction sensor or an image sensor are disposed, and sensor data regarding a user from a plurality of types of sensors is processed to determine a health condition (a diabetic state or a stress state) of the user.

PRIOR ART DOCUMENTS

PATENT DOCUMENT

[0005]

Patent Document 1: Japanese Patent Application Laid-open Publication No. 2020-184349

NON-PATENT DOCUMENT

[0006]

Non-Patent Document 1: National Center for Global Health and Medicine, Diabetes and Metabolism Information Center, “Exercise for Diabetes”, [online], June 8, 2016, < URL: <https://dmic.ncgm.go.jp/general/about-dm/040/040/03.html> >

SUMMARY OF THE INVENTION

PROBLEMS TO BE SOLVED BY THE INVENTION

[0007]

However, there is room for improvement in the above-described solutions, and a system capable of proposing an improvement in blood glucose level more suitable for each user is demanded in order to prevent diabetes. The present invention has been made to solve this problem, and an object of the present invention is to provide an information provision device, an information provision method, and an information provision program capable of proposing an improvement of a blood glucose level more

suitable for each user.

MEANS FOR SOLVING THE PROBLEM

[0008]

An information provision device according to the present invention that is connected to a user terminal of a user via a network and provides information for improving a blood glucose level of the user includes a first learning device that has been trained to receive blood glucose level information about a blood glucose level of the user during a prescribed period, meal information about a meal taken by the user during the prescribed period, and action information about an action performed by the user during the prescribed period and to output recommendation information including at least one of a meal and an improving agent for improving the blood glucose level of the user, an information control unit that receives input information input into the first learning device, and a transmission unit that transmits the recommendation information output from the first learning device to the user terminal.

[0009]

In the information provision device, the first learning device can further learn to output the recommendation information including a recommended action for improving a blood glucose level.

[0010]

In the information provision device, the first learning device can further be trained using the physical information about the user as an input.

[0011]

In the information provision device, the first learning device can further be trained using intestinal flora of the user as an input.

[0012]

The information provision device may further include a shipping instruction unit that instructs the user to ship the supplement.

[0013]

The information provision device may further include a correction unit that corrects an output result from the first learning device and outputs the recommendation information.

[0014]

The information provision device may further include a second learning device that has been trained to receive physical information about the user, past blood glucose level information about a blood glucose level of the user measured before the predetermined period, and the meal information, and output the blood glucose level information. The information acquisition unit may be configured to receive the blood glucose level information output from the second learning device.

[0015]

An information provision system according to the present invention includes any one of the above-described information provision devices and at least one mobile terminal.

[0016]

An information provision method according to the present invention for providing information for improving a blood glucose level of a user in an information provision device connected to a user terminal of the user via a network includes receiving information to be input to a first learning device that has been trained to receive blood glucose level information about a blood glucose level of the user during a prescribed period, meal information about a meal taken by the user during the prescribed period, and action information about an action performed by the user during

the prescribed period and to output recommendation information including at least one of a meal and improving agent for improving the blood glucose level of the user, outputting the recommendation information from the first learning device, and transmitting the recommendation information to the user terminal.

[0017]

An information provision program according to the present invention for providing information for improving a blood glucose level of a user includes causing a computer of the information provision device to receive information to be input into a first learning device that has been trained to receive blood glucose level information about a blood glucose level of the user during a prescribed period, meal information about a meal taken by the user during the prescribed period, and action information about an action performed by the user during the prescribed period and to output recommendation information including at least one of a meal and improving agent for improving the blood glucose level of the user, causing the computer to output the recommendation information from the first learning device, and causing the computer to transmit the recommendation information to the user terminal.

ADVANTAGES OF THE INVENTION

[0018]

According to the present invention, a more suitable improvement in a blood glucose level can be proposed to each user.

BRIEF DESCRIPTION OF THE DRAWINGS

[0019]

Fig. 1 shows a graph illustrating an example of changes in blood glucose levels of three persons for one day.

Fig. 2 shows an image diagram proposing lunch for lowering the blood glucose

levels after meal.

Fig. 3 shows a schematic configuration diagram of an information provision system according to an embodiment of the present invention.

Fig. 4 shows a block diagram illustrating an example of a hardware configuration of a mobile terminal.

Fig. 5 shows a block diagram illustrating an example of a hardware configuration of a measurement terminal.

Fig. 6 shows a block diagram illustrating an example of a hardware configuration of a mobile terminal.

Fig. 7 shows a block diagram illustrating an example of a hardware configuration of a server.

Fig. 8 shows a diagram illustrating an operation of a learning device.

Fig. 9 shows a diagram illustrating another example of the operation of the learning device.

Fig. 10 is a table P including an inappropriate food and an inappropriate action for each user.

Fig. 11 shows a block diagram illustrating an example of a hardware configuration of the server.

Fig. 12 shows a diagram illustrating an example of a screen of recommendation information provided to a user.

Fig. 13 shows an example of a screen of a periodic report provided to a user.

Fig. 14 shows a flowchart of an operation of the information provision system.

Fig. 15 shows a flowchart of output of a recommended meal list.

Fig. 16 shows a flowchart of output of a recommended meal list.

Fig. 17 shows a flowchart of output of a recommended action list.

Fig. 18 shows a flowchart of output of a recommended action list.

Fig. 19 shows a diagram illustrating an operation of the learning device that outputs blood glucose level information.

EMBODIMENTS OF THE INVENTION

[0020]

<1. Outline of information provision system>

Hereinafter, an information provision system according to an embodiment of the present invention will be described with reference to the drawings. An information provision system according to the present embodiment is a system that provides information for improving a blood glucose level of a user in order to prevent diabetes.

[0021]

First, an outline of an improvement in a blood glucose level by a meal will be described. Fig. 1 shows a graph illustrating an example of changes in blood glucose levels of three persons for one day. The timing of meal and exercise of B is shown as a reference. A blood glucose level fluctuates mainly based on a meal and exercise. In this example, since the blood glucose level of B is higher than a normal value, B considers to make the blood glucose level approach the normal value.

[0022]

Fig. 2 shows an image diagram proposing lunch for lowering the blood glucose levels after meal. In this drawing, a case of predicting a lunch type and a blood glucose level (AUC) before noon is assumed. For example, a predicted blood glucose level in a case where B takes lunch F1 is indicated by (1) shown in a blood glucose level graph, and a predicted blood glucose level in a case where B takes meal F2 is indicated by (2). The AUC predicted after meal F2 is recommended because the AUC is lower after meal F2 than after meal F1. Note that the meal recommendation may be

given for each meal in this manner, or a meal for one day or a plurality of days can be recommended. The same applies also to the action (exercise). Hereinafter, such a system that improves the blood glucose level will be described in detail.

[0023]

As illustrated in Fig. 3, the information provision system includes at least one user terminal 100 of a user and a server (information provision device) 500 that are connected via a network 700 such as the Internet. In addition, the server 500 can transmit and receive information to and from a shipping center 600, which is a facility for shipping a supplement (improving agent) and the like, described later, to the user, via the network 700. Hereinafter, the configuration of the system will be described in detail.

[0024]

<2. User terminal>

<2-1. Outline of user terminal>

As illustrated in Fig. 3, the user terminal 100 according to the present embodiment includes a mobile terminal 1 and a measurement terminal 2 that is connected to the mobile terminal 1 in a wireless or wired manner and measures a blood glucose level of a user. In this user terminal, blood glucose level information measured by the measurement terminal 2 is transmitted to the mobile terminal 1. Hereinafter, the mobile terminal 1 and the measurement terminal 2 will be described in detail.

[0025]

<2 -2. Mobile terminal>

Fig. 4 shows a block diagram illustrating an example of a hardware configuration of the mobile terminal. As illustrated in Fig. 4, the mobile terminal 1 is

a computer that is electrically connected to a control unit 11, a storage unit 12, a communication interface 13, a touch panel display 14, a speaker 15, a microphone 16, and a camera 17. Note that in Fig. 4, the communication interface is referred to as a “communication interface (I/F)”. The same applies also to Fig. 7 described later.

[0026]

The control unit 11 includes a central processing unit (CPU) that is a hardware processor, a random access memory (RAM), a read only memory (ROM), and the like, and controls the respective components in accordance with information processing. The storage unit 12 includes a hard disk drive, a solid state drive, an optical disk, a magnetic disk, a flash memory, a memory card, and the like. The storage unit stores various data such as a terminal program 121, user information 122 including physical information about a user, blood glucose level information 123 transmitted from the measurement terminal 2, user meal information 124, user action information 125, bacterial flora information 126 about user's intestinal flora, and recommendation information 127 transmitted from the server 500.

[0027]

The terminal program 121 is software for collecting the blood glucose level information 123 and the like from the measurement terminal 2, managing various data including the collected blood glucose level information 123 and the like, and communicating with the server 500. Details thereof will be described later. The user information 122 is physical information about a user, and can include information about age, sex, height, weight, chest circumference, abdominal circumference, body mass index (BMI), body fat percentage, HbA1c, medical history, medical examination result, and the like. These pieces of information may be directly input to the mobile terminal 1 by a user, or may be input in cooperation with an external database in which the user

information is already stored. The user information 122 can be input by various methods such as a questionnaire form. At least one piece of the user information 122 is used as an input to a learning device 522 described later. The blood glucose level information 123 is collected by operating the terminal program 121 after communication is established between the mobile terminal 1 and the measurement terminal 2.

[0028]

The meal information 124 is information about contents and amounts of meals and beverages (breakfast, lunch, dinner, snack, and the like) taken by a user, a time of taking the meals, and the like, and the information is input to the mobile terminal 1 by the user. The Meal information 124 is not particularly limited, but may include, for example, estimated raw materials, estimated energy, nutrients, weight, and the like. These pieces of information can be automatically calculated based on the meal contents in the mobile terminal 1, or can be transmitted to the server 500, calculated in the server 500, and transmitted to the mobile terminal 1. At this time, based on the meals photographed by the camera 17, these pieces of information can be calculated in addition to the meal contents by an image processing technique. At least one piece of the meal information 124 is used as an input to the learning device 522 described later. Further, the user can input the meal information 124 to the mobile terminal 1 using a method for answering a questionnaire. Such meal information 124 may not be able to be fully input, and may be able to partially acquire a meal, a snack, a beverage, or the like as an input to a human body. Further, instead of the direct input of a meal or the like, a weight, a body fat percentage, or the like can be measured and input as an output of a meal.

[0029]

The action information 125 is information about an action (in particular, exercise) performed by a user, and information about an exercise type, an exercise time, a time zone during which an exercise is performed, and the like. However, the action information 125 is also not particularly limited, and can include estimated energy consumption, estimated load, estimated heart rate or pulse rate, oxygen saturation (SpO2), blood pressure, and the like. These pieces of information can be automatically calculated based on the action contents in the mobile terminal 1 or the measurement terminal 2, or can be transmitted to the server 500, calculated in the server 500, and transmitted to the mobile terminal 1. Further, the information can also be measured with an installation instrument such as a fitness bike. At least one piece of the action information 125 is used as an input to the learning device 522 described later.

[0030]

The intestinal flora information 126 is information about intestinal flora of a user. Specifically, the intestinal flora information is information including the diversity of bacteria, the proportion of main bacteria, and the like, and is measured from the feces of the user in a specialized institution. In general, since the intestinal flora information is obtained by a stool test using a test kit and analysis performed by a specialized institution, the intestinal flora information is often acquired by specifying a user with inter-server communication from the specialized institution. Since the acquisition frequency of the intestinal flora information 126 is not high, for example, the information can be acquired at least once within the past 1 year. At least one piece of the intestinal flora information 126 is used as an input to the learning device 522 described later.

[0031]

The recommendation information 127 is information transmitted from the

server 500, and is information about a meal, a supplement (including medicine), and an action (in particular, exercise) recommended for lowering a blood glucose level.

[0032]

The communication interface 13 is a wired local area network (LAN) module, a wireless LAN module, or the like, and is an interface for performing wired or wireless communication via a network. The type of the communication interface 13 may be appropriately configured according to a connection target or a type of communication standard. In the present embodiment, the mobile terminal 1 is connected to the measurement terminal 2 and the server 500 via the communication interface 13. For example, Bluetooth (registered trademark) can be used for the communication between the mobile terminal 1 and the measurement terminal 2, for example. Alternatively, the mobile terminal 1 and the measurement terminal 2 can be connected by wire.

[0033]

The touch panel display (hereinafter, it may be simply referred to as a display.) 14 may be a known one, and is used for touch operation for selection, input of characters and the like, and display of images and the like. The user can operate the mobile terminal 1 via the touch panel display 14. The speaker 15 and the microphone 16 each may be known ones, and are used for outputting and inputting a voice. The camera 17 is a known camera used in the mobile terminal, and is used for various image capturing in addition to image capturing of the meals described above.

[0034]

Note that, as for a specific hardware configuration of the mobile terminal 1, components can be appropriately omitted, replaced, and added according to embodiments. For example, the control unit 11 may include a plurality of hardware processors. The hardware processors may include a microprocessor, a field-

programmable gate array (FPGA), or the like. Further, the mobile terminal 1 may be a mobile terminal including a tablet personal computer (PC) and a smartphone in addition to an information processing apparatus designed exclusively for services to be provided.

[0035]

Further, the mobile terminal 1 may be connected to a drive device or the like for reading data stored in a storage medium. In this case, the terminal program 121 can be provided via a storage medium. Further, in a case where the drive device is connected to the mobile terminal 1, the terminal program 121 can be stored in a storage medium. The storage medium is a medium that accumulates information such as the program by electrical, magnetic, optical, mechanical, or chemical action so that a computer, other devices, a machine, or the like can read the recorded information such as the program. The storage medium is a compact disk (CD), a digital versatile disk (DVD), a flash memory, or the like.

[0036]

<2 -3. Measurement terminal>

Fig. 5 shows a block diagram illustrating an example of a hardware configuration of a measurement terminal. As illustrated in Fig. 5, the measurement terminal 2 is attached to a user so as to be in direct or indirect contact with a body, and is used to continuously measure a blood glucose level. Specifically, the measurement terminal 2 is a computer including a controller 21, a display unit 22 connected to the controller 21, an operation unit 23, a RAM 24, a storage unit 25, a communication unit 26, and a measurement unit 27.

[0037]

The controller 21 is configured to control the operations of the respective units using a microcomputer, a field-programmable gate array (FPGA), or the like. The

display unit 22 is configured to be able to display various types of information by a liquid crystal display, an organic electroluminescence (EL) display, or the like. The operation unit 23 is appropriately configured to be able to receive an operation from a user through a button, a touch panel, or the like. The operation unit 23 may be configured by a button physically provided in the measurement terminal 2.

Furthermore, in a case where the touch panel display is used as the display unit 22, the operation unit 23 may include a virtual button displayed on the display unit 22.

[0038]

The RAM 24 may be a DRAM, a static RAM (SRAM), or the like, and temporarily stores data and is used as a work storage area of the controller 21. The storage unit 25 includes a hard disk drive, a solid state drive, an optical disk, a magnetic disk, a flash memory, a memory card, or the like, and stores biological data (for example, various measured values, index values calculated from the measured values, and the like) obtained by measurement.

[0039]

The communication unit 26 is similar to the communication interface 13, and is a wired LAN module, a wireless LAN module, or the like. The measurement terminal 2 is connected to the mobile terminal 1 via the communication unit 26.

[0040]

The measurement unit 27 continuously measures a blood glucose level, and can be configured by known continuous glucose monitoring (CGM), flash glucose monitoring (FGM), or the like. When the measurement unit 27 is configured by the CGM or FGM, the concentration of glucose in a subcutaneous tissue interstitial fluid is measured, and a value obtained by estimating the blood glucose level from the concentration is calculated as a blood glucose level. However, the measurement unit

27 is not particularly limited as long as it can continuously or periodically (for example, every 5 minutes, etc.) measure a blood glucose level. That is, there exist a method for acquiring and analyzing blood, a method for measuring with a device with a continuous needle, a method for measuring in contact with retina, a method for measuring with reflection by applying light from a light source to a blood vessel, and the like, but any method can be used.

[0041]

In addition, the measurement unit 27 may be configured to be able to acquire the number of steps, a moving distance, a moving speed, a blood pressure, a heart rate, an electrocardiogram, a body motion, a body temperature, a body weight, a temperature, a humidity, and the like. That is, the action information can be acquired by the measurement terminal 2.

[0042]

The blood glucose level information acquired by the measurement unit 27 is digitized by analog-digital (A-D) conversion and stored in the storage unit 25 by the controller 21. Further, the blood glucose level information stored in the storage unit 25 is transmitted to the mobile terminal 1 via the communication unit 26. At this time, the blood glucose level information is periodically or continuously transmitted to the mobile terminal 1. Note that the blood glucose level information may include a blood glucose rising curve, an incremental area under the curve (AUC), and the like.

[0043]

Note that, as for a specific hardware configuration of the measurement terminal 2, components can be appropriately omitted, replaced, and added according to embodiments similarly to the mobile terminal 1. Further, in the measurement terminal 2 according to the present embodiment, the measurement unit 27 and a portion that

executes various types of information processing (the controller 21, the RAM 24, the storage unit 25, and the communication unit 26) are integrated, but these may be separated. Further, such a measurement terminal 2 can also be distributed from a provider of this system to a user.

[0044]

<2-4. Software configuration of mobile terminal>

Fig. 6 shows a block diagram illustrating an example of a hardware configuration of the mobile terminal. The control unit 11 of the mobile terminal 1 develops the terminal program 121 stored in the storage unit 12 in the RAM. The control unit 11 then causes the CPU to interpret and execute the terminal program 121 developed in the RAM to control the respective components. As a result, as illustrated in Fig. 6, the mobile terminal 1 is configured as a computer including, as software modules, a blood glucose level information acquisition unit 111, a communication control unit 112, a display control unit 113, and an input control unit 114. Hereinafter, these functional configurations will be described.

[0045]

The blood glucose level information acquisition unit 111 communicates with the measurement terminal 2 to periodically or continuously collect blood glucose level information and the like from the measurement terminal 2. The collected blood glucose level information 123 is then stored in the storage unit 12. The communication control unit 112 has a function of periodically (for example, every other hour, every other meal, every other day, every two days, every other week, or the like) or continuously transmitting the user information 122, the blood glucose level information 123, the meal information 124, the action information 125, the intestinal flora information 126, and the like stored in the storage unit 12 to the server 500, and

receiving various data such as the recommendation information 127 from the server 500. In addition, the communication control unit also has a function of storing the various data received from the server 500 in the storage unit 12.

[0046]

The display control unit 113 has a function of displaying the various types of information stored in the storage unit 12, various types of information transmitted from the server 500, and the like on the touch panel display 14. For example, this function is for, when the terminal program 121 is activated, displaying a screen for user registration or displaying various types of information received from the server 500 according to a predetermined format. The input control unit 114 has a function of receiving input of information such as the user information 122, the blood glucose level information 123, the meal information 124, the action information 125, and the intestinal flora information 126 about a user from the touch panel display 14, and storing the information in the storage unit 12.

[0047]

<3. Server>

<3-1. Hardware configuration of server>

Next, the server 500 will be described. Fig. 7 shows a block diagram illustrating an example of a hardware configuration of the server. As illustrated in Fig. 7, the server 500 is a computer to which a control unit 51, a storage unit 52, and a communication interface 53 are electrically connected.

[0048]

The control unit 51 includes a CPU that is a hardware processor, a RAM, a ROM, and the like, and controls the respective components in accordance with information processing. The storage unit 52 stores various type of information such as

an information provision program 521, a trained learning device 522, training data 524, a user information database (DB) 525, a recommendation information DB 526, and content data 527.

[0049]

<3-1-1. Information provision program>

The information provision program 521 is a program for executing various processing for outputting recommended meals, actions, supplements, and the like and performing for supporting a user in order to improve a blood glucose level based on the user information 122, the blood glucose level information 123, the meal information 124, the action information 125, and the intestinal flora information 126 received from the mobile terminal. Specific processing will be described later.

[0050]

<3-1-2. Trained learning device>

As illustrated in Fig. 8, the trained learning device (first learning device) 522 is trained to output the recommendation information 127 about a meal, a supplement, and an action recommended to improve the blood glucose level when receiving the user information 122, the blood glucose level information 123, the meal information 124, the action information 125, and the intestinal flora information 126 described above. Specifically, for example, the trained learning device is a publicly-known neural network that includes a multilayer structure and is used for so-called deep learning, and includes an input layer, an intermediate layer (hidden layer), and an output layer in order from an input. Further, a learning device that has trained by other publicly-known machine learning may be used.

[0051]

Among the input information, the blood glucose level information 123, the

meal information 124, and the action information 125 can be information obtained during a predetermined period. For example, the blood glucose level information 123 may be information about a blood glucose level every predetermined time (for example, every 30 minutes) for the past few hours, the past one day, or the past few days. The meal information 124 may be information about recent meals, meals for the past one day, and meals for the past few days. The action information 125 may be information about the exercise performed most recently, the exercise performed for the past one day, and the exercise performed for the past few days. Since the intestinal flora information 126 cannot be acquired frequently, it can be information at least once within the past 1 year. Note that the intestinal flora information 126 is not necessarily required, and the learning device 522 can be trained after receiving the blood glucose level information 123, the meal information 124, and the action information 125.

[0052]

The recommendation information 127 may also be the recommendation information during a predetermined period. For example, the information may include meals and supplements to be taken and actions to be taken during the future period such as the next day, the next few days, and the next one month. Note that the learning device may be trained so that the recommendation information 127 includes only any one of meals and supplements. Further, the actions can be included in the recommendation information 127 as necessary, and the learning device can be trained so that actions are not included in the recommendation information.

[0053]

Note that, as described above, the information output from the trained learning device 522 can be directly used as the recommendation information 127, but for example, as illustrated in Fig. 9, a correction unit 550 that corrects the recommended

information may be installed. For example, the correction unit 550 compares a table P for inappropriate foods and the inappropriate actions for respective users as illustrated in Fig. 10 prepared in advance with a recommended food list and a recommended action list that are output from the trained learning device 522. In a case where the foods and actions included in the table P are included in the recommended food list and the recommended action list, the correction unit deletes the foods and actions in the lists and outputs the recommendation information 127. The table P regarding such inappropriate meals and actions can be prepared by various methods. For example, the table may be created based on a questionnaire for a user, and the learning device 522 may be trained to be capable of outputting inappropriate foods and actions. The table P in Fig. 10 may be updated while the information provision system is used. For example, in a case where a user has a pain in the lower back, an action using the waist may be added to the table P, or an action, food, or supplement that have no effects after trial may be added to the table P. The table P may be created or updated manually or automatically by the correction unit 550.

[0054]

<3-1-3. Training data>

The training data 524 is data collected in advance from a plurality of subjects (test users) in order to output recommended meals, supplements, and actions, and is particularly for training the learning device 522. For example, based on the experience of the subjects, physical information, blood glucose level information, meal information, action information, and intestinal flora information about the subjects are input, and correspondingly, meals, supplements, and actions at a time when the blood glucose level decreases are output and included in the training data 523. For example, in a case where there is data that a blood glucose level at 2 hours after meal rises after

eating tomato and walking 8000 steps or more, such data is included in the training data. Further, the training data 523 is appropriately updated by data collected from a new subject, additional data from a subject already stored, and the like, and the learning device is retrained by the updated training data. Note that as described later, the blood glucose level information may include a blood glucose rising curve, an area under the concentration curve (AUC), and the like.

[0055]

<3-1-4. User information DB>

The user information database (DB) 525 is a database where information about a user is stored, and can store various types of user information about this information provision system, such as a use history of the user in addition to the user information 122, the blood glucose level information 123, the meal information 124, the action information 125, and the intestinal flora information 126 transmitted to the server 500, and the recommendation information 127 transmitted to the mobile terminal.

[0056]

<3-1-5. Recommendation information DB>

The recommendation information DB 526 is a database including data collected from a subject for training data, and further including a meal, a supplement, and an action to be recommended. As will be described later, the database includes physical information, blood glucose level information, meal information, action information, and intestinal flora information about a subject, which are used in individually recommending a meal or action, and data related to a meal, a supplement, and an action that contribute to lowering or preventing a raise in a blood glucose level. In addition, the blood glucose level information can include an area under the concentration curve, a tilt of the blood glucose concentration curve at a time of a rises,

the maximum value of the blood glucose concentration curve, and the like.

Furthermore, information about a meal, supplement, and action to be recommended can be appropriately extracted as general information and provided to the user.

[0057]

A meal that lowers a blood glucose level and prevents a raise in a blood glucose level includes a food having a low GI value, and for example, leaf vegetables such as lettuce, yoghurt, nuts, brown rice as carbohydrates and the like are known as such a food.

[0058]

Supplements (including medicine) for lowering a blood glucose level have, for example, an effect of controlling a blood glucose level by adding indigestible dextrin to supplements, and an effect of moderating moisture absorption of a carbohydrate by food or supplements containing salacia derived salacinol. The medicine includes a biguanide drug that controls synthesis of sugar in a liver, and a thiazolidine drug that improves insulin resistance in skeletal muscle and a liver.

[0059]

Examples of the action for lowering a blood glucose level include exercise such as walking, jogging, or muscle exercise, and an increase in a blood glucose level after a meal can be controlled by performing the exercise within one hour after a meal.

[0060]

<3-1-6. Content data>

The content data 527 includes data for generating a screen to be displayed on the mobile terminal 1. In the mobile terminal 1 of the present embodiment, as described later, contents related to periodic reports and recommendation information notifications are displayed. Further, the content data 527 is material data for

generating the contents, and includes for example, findings based on a history of user data transmitted periodically, findings regarding recommendation information, and the like as fixed phrases, and these materials are provided in combination in accordance with a user's situation.

[0061]

<3-1-7. Others>

Since hardware such as the communication interface 53 has substantially the same configuration as that of the mobile terminal 1, description thereof is omitted. Note that a display, a speaker, a microphone, and the like can be disposed as necessary, similarly to the mobile terminal 1.

[0062]

<3-2. Software configuration of server>

Fig. 11 shows a block diagram illustrating an example of a hardware configuration of the server. The control unit 51 of the server 500 develops the information provision program 521 stored in the storage unit 52 in the RAM. The control unit 51 then causes the CPU to interpret and execute the information provision program 521 developed in the RAM and to control the respective components. As a result, as illustrated in Fig. 11, the server 500 is configured as a computer including, as software modules, an information acquisition unit 511, a communication control unit 512, an output unit 513, a learning unit 514, and a shipping instruction unit 515. Hereinafter, these functional configurations will be described.

[0063]

<3-2-1. Information acquisition unit>

The information acquisition unit 511 communicates with the mobile terminal 1 to collect the user information 122, the blood glucose level information 123, the meal

information 124, the action information 125, the intestinal flora information 126, and the like transmitted from the mobile terminal 1. The collected various information is then stored in the user information DB 525 for each user. Furthermore, the acquired information is input to the trained learning device 522.

[0064]

<3-2-2. Communication control unit>

The communication control unit (transmission unit) 512 has a function of controlling communication with the mobile terminal 1. Specifically, the communication control unit 512 has a function of transmitting the recommendation information 127 to the mobile terminal 1 or receiving the above-described various data from the mobile terminal 1 based on a predetermined condition.

[0065]

<3-2-3. Output unit>

The output unit 513 inputs the information acquired by the information acquisition unit 511 to the trained learning device 522 and outputs the recommendation information 127. The output unit 513 generates data in a predetermined display format based on the further output recommendation information 127, and the communication control unit 512 transmits the data to the mobile terminal 1. The data in the predetermined display format is, for example, data for displaying a screen transmitted every day as illustrated in Fig. 12. On the screen illustrated in Fig. 12, regarding a meal, a meal recommended for each meal is shown. Regarding an action, a recommended action (exercise) is shown. Further, fixed phrases are extracted from the content data 527 in accordance with the recommendation information 127, and added as advice. Further, the advice may be a sentence obtained by optimizing a fixed phrase stored in the content data 527 based on the recommendation information 127.

Furthermore, an image or a moving image (for example, moving images related to stretching and aerobic exercise) are extracted from the content data 527 and can be added to the screen. In a case where a supplement is recommended, information about a type and dosage is displayed. The output time of the recommendation information 127 can be appropriately set, for example, to every predetermined period, at arbitrary time, every day, every three days, every week, or the like. In addition, the recommendation information 127 can be acquired at arbitrary time in response to a request from a user. For example, before meal or exercise, such as before every meal or before every exercise, the output unit 513 can acquire the recommendation information 127 based on data up to immediately before the meal or exercise, and transmit this information to the mobile terminal 1. A user can take a meal or exercise based on the acquired recommendation information 127.

[0066]

Further, the output unit 513 also has a function of generating contents such as the periodic report described above based on the output recommendation information 127. For example, as illustrated in Fig. 13, the periodic report can include a weight, calorie intake, transition of the amount of exercise, and the like of a user. Further, the output unit 513 can also transmit the recommendation information 127 to a cooperating external device in addition to the mobile terminal 1. For example, a recommended action can be transmitted as a target setting value to a fitness bike or the like that cooperates with the user. Note that, as described above, in a case where the output information from the learning device 522 is corrected, the output unit 513 includes the correction unit 550.

[0067]

<3-2-4. Learning unit>

The learning unit 514 has a function of causing the learning device 522 to be trained based on the training data 524. For example, when the training data 524 is updated, the learning device 522 is trained by the updated training data 524.

[0068]

<3-2-5. Shipping instruction unit>

Next, the shipping instruction unit 515 will be described. When the output unit 513 determines a recommended supplement (including medicine), the shipping instruction unit 515 transmits personal information about a user and a recommended supplement to the shipping center 600. As a result, the supplement is delivered from the shipping center 600 to the user.

[0069]

<4. Processing in information provision system>

Next, the processing in the information provision system configured as described above will be described with reference to Fig. 14. Fig. 14 shows a flowchart illustrating the processing in the information provision system.

[0070]

First, the user causes the mobile terminal 1 to display a predetermined input screen on, and to receive the user information 122, the meal information 124, the action information 125, and the intestinal flora information 126 (step S11). Among these pieces of information, the user information 122 and the intestinal flora information 126 can be received at the time of initial registration and entry can be performed in the information only when a change occurs. For example, an entry is made on the meal information 124 and the action information 125 every predetermined period described above. For example, an entry can be made on the meal information after every meal, and on the action information every day.

[0071]

Further, the blood glucose level information 123 is acquired from the measurement terminal 2 (S12). Since the blood glucose level information 123 is continuously measured, this information can be obtained periodically or sequentially. Therefore, the information is acquired in parallel with step S11. The information thus obtained is transmitted to the server 500 every predetermined period (S13).

[0072]

In the server 500, the information acquired from the mobile terminal 1 is input to the learning device 522, and the recommendation information 127 is output (S14). The output recommendation information 127 is embedded in data for generating the screen as illustrated in Fig. 12 described above, and is transmitted to the mobile terminal 1 (S15). Further, a supplement included in the recommendation information 127 is transmitted to the shipping center by the above-described shipping instruction unit 515, and is delivered from the shipping center to a user (step S16).

[0073]

<5. Features>

As described above, according to the present embodiment, the trained learning device 522 outputs the recommendation information 127 and provides it to a user based on the user information 122, the blood glucose level information 123, the meal information 124, the action information 125, and the intestinal flora information 126 about the user. This can make a proposal for improving a blood glucose level more suitable for an individual. That is, the recommendation information 127 is not simply provided based on physical information or a blood glucose level of a user, but the recommendation information 127 is output further together with the meal information 124, the action information 125, and the intestinal flora information 126. Thus, the

accuracy of the proposal for improving a blood glucose level can be improved.

[0074]

<6. Modifications>

Although one embodiment of the present invention has been described above, the present invention is not limited thereto, and various modifications can be made.

Note that the following modifications can be appropriately combined.

[0075]

(1) Instead of transmitting the blood glucose level information 123 from the mobile terminal 1 to the server 500, the blood glucose level information 123 can also be transmitted from the measurement terminal 2 to the server 500 without via the mobile terminal 1. In this case, a server dedicated to collecting the blood glucose level information 123 can be prepared, the blood glucose level information 123 can be provided from this server to the server 500 described above, and a blood glucose level improvement service can be provided from the server 500.

[0076]

(2) The storage unit 52 included in the server 500 can be divided into a plurality of units for corresponding types of information. Further, a plurality of servers can be provided in accordance with functions (for example, the functional components 511 to 515) required for the server 500. Furthermore, the output unit 513 can be divided into two, that is, an output unit that outputs a meal and an output unit that outputs an action. This point will be described.

[0077]

(2-1) Meal recommendation 1

A description will be given with reference to a flowchart of Fig. 15. Here, the incremental area under the curve (hereinafter, AUC) is defined as blood glucose level

information. First, the AUCs for predetermined times (for example, 3 hours) after breakfast, lunch, and dinner are calculated in the measurement terminal 2 or the mobile terminal 1 based on the blood glucose level information 123, and an average AUC of the calculated AUCs is calculated (step S21). This calculation can also be performed in the server 500. The same applies also to each recommendation described later. Next, the output unit 513 extracts information from the recommendation information DB 526, and creates a meal list including a plurality of meals suitable for lowering the average AUC. Specifically, a plurality of subjects approximate to the physical information about a user is selected, and a plurality of meals that is taken by the subjects and contributes to lowering the average AUC is selected. Such a meal list can include, for example, a plurality of (for example, about three types) meals for each of breakfast, lunch, and dinner. Thus, the recommended meal list is created (step S22). Based on the recommendation information DB 526, the output unit 513 can create the above-described recommended meal list by, for example, a machine learning method such as clustering or collaborative filtering. This point can also apply to each recommendation described later.

[0078]

Note that in order to cope with long-term improvement in a blood glucose level, an average AUC for a long period (for example, the past one year) such as the past few months or the past one year instead of the predetermined time after a meal. Such processing can be applied to, for example, a case where a blood glucose level is higher than that one year ago and thus this situation is desired to be dealt with.

[0079]

(2-2) Meal recommendation 2

A description will be given with reference to a flowchart of Fig. 16. In the

description about the meal recommendation 1, the average AUC is used, but here, an average of tilts at a time when a rise in blood glucose level in an incremental area under the curve (for example, the tilt between the lowest point and the highest point of a rising curve, hereinafter referred to as “AUC tilt”) is used. First, the AUC tilts for predetermined times (for example, 3 hours) after breakfast, lunch, and dinner are calculated in the measurement terminal 2 or the mobile terminal 1 based on the blood glucose level information 123 (step S31). Next, the output unit 513 extracts information from the recommendation information DB 526, and creates a meal list including a plurality of meals suitable for making the AUC tilts equal to or less than a predetermined threshold. Specifically, a plurality of subjects approximate to the physical information about a user is selected, and a plurality of meals that is taken by the subjects and contributes to making the AUC tilts equal to or less than the predetermined threshold is selected. Thus, the recommended meal list is created similarly to the description in the meal recommendation 1 (step S32). Note that instead of the AUC tilt, the maximum value of the blood glucose rising curve can also be used.

[0080]

The above processing is for coping with a short-term improvement in a blood glucose level, and can be applied to, for example, a case where a hyperglycemic spike occurs yesterday but make it difficult for the hyperglycemic spike to occur today.

[0081]

(2-3) Action recommendation 1

A description will be given with reference to a flowchart of Fig. 17. Here, AUC is blood glucose level information. First,, an average AUC for a long period of time (for example, the past one year) such as the past few months or the past 1 year is

calculated in the measurement terminal 2 or the mobile terminal 1 based on the blood glucose level information 123 (step S41). Next, the output unit 513 extracts information from the recommendation information DB 526, and creates an action list including a plurality of actions suitable for lowering the average AUC. Specifically, an action list (list A1) including actions frequently performed by subjects and falling below the average AUC is created based on data of all the subjects (step S42). Next, an action list (list B1) in which actions frequently performed by subjects exceeding the average AUC is created based on data of all the subjects (step S43). Then, an action list (list C1) including actions frequently performed in the list A but rarely performed in the list B is created (step S44). Next, actions performed by a subject approximate to the physical information of a user are selected from the list C1, and a plurality of (for example, about three) actions is selected from the selected actions, and a recommended action list is created (step S45).

[0082]

(2-4) Action recommendation 2

A description will be given with reference to a flowchart of Fig. 18. In the description about action recommendation 1, the average AUC is used, but here, an AUC tilt calculated based on the long-term blood glucose level information is calculated (step S51). Next, the output unit 513 extracts information from the recommendation information DB 526, and creates an action list including a plurality of actions suitable for lowering the AUC tilt. Specifically, an action list (list A2) including actions frequently performed by subjects and falling below a predetermined threshold of the AUC tilt is created based on data of all the subjects (step S52). Next, an action list (list B2) including actions frequently performed by subjects and exceeding the predetermined threshold of the AUC tilt is created based on the data of all the subjects

(step S53). Then, an action list (list C2) including actions frequently performed in the list A2 but rarely performed in the list B2 is created (step S54). Next, actions performed by a subject approximate to the physical information of a user are selected from the list C2, and a plurality of (for example, about three) actions is selected from the selected actions, and a recommended action list is created (step S55). Note that instead of the AUC tilt, the maximum value of the blood glucose rising curve can also be used.

[0083]

(3) In the above embodiment, the blood glucose level is continuously measured by the measurement terminal 2, but in a case where such a measurement terminal 2 cannot be prepared, a current blood glucose level can be output by machine learning based on information such as the blood glucose level of a user measured in the past. For example, as illustrated in Fig. 19, a trained learning device (second learning device) 529 that outputs a current blood glucose level is prepared in the server 500. The learning device 529 is trained to receive, as input, the user information 122, past blood glucose level information 129, the meal information 124, the action information 125, the intestinal flora information 126, and genetic information 130 included in the training data 524 that are generated by referring to the training data 523, and to output a current blood glucose level. The past blood glucose level information 129 is information about at least one blood glucose level measured by a subject in the past, and for example, at least one blood glucose level, HbA1c, or the like measured in the past 1 year can be used. The genetic information 130 can be, for example, genetic information that can be discriminated that the risk of diabetes is high. The learning device 529, even if the current blood glucose level cannot be measured, can predict the current blood glucose level as the blood glucose level information 123 using each piece

of the above information. The blood glucose level information 123 to be output is not particularly limited, and can be current or future blood glucose level information. For example, the learning device 529 can be trained to receive information up to the time T (for example, time-series information such as every 30 minutes) as the meal information 124 and the exercise information 125, and to output the blood glucose level information 123 as information about a predetermined time series after the time T. Note that the input information only needs to include at least the user information 122, the meal information 124, and the past blood glucose level information, and in addition, when at least one piece of the action information 125, the genetic information 130, and the intestinal flora information 126 is added as an input, highly accurate blood glucose level information 128 can be acquired.

[0084]

The blood glucose level information 128 thus calculated is input to the learning device 522 illustrated in Fig. 7, and the recommendation information 127 is output. Therefore, when using the system for the first time, a user may only transmit the past blood glucose level information 129 measured in the past to the server 500 or the past blood glucose level information 129 measured periodically to the server 500, and thus the two learning devices 522 and 529 in the server 500 can output the recommendation information 127 without the measurement terminal 2 that continuously measures a continuous blood glucose level.

[0085]

(4) The terminal program 121 executed by the mobile terminal 1 according to the above embodiment can be performed by executing a dedicated application, but after an access to a web site provided by a server, on the web site, daily life data can be input by the mobile terminal described above and various reports and the like can be

displayed on the mobile terminal.

[0086]

(5) In order to prompt taking of recommended supplements and actions, points can be provided every time of supplements and actions, and products can be purchased using the points. Further, Information can be exchanged and motivation can be improved by providing a dedicated community, a social networking service (SNS), bulletin boards, and the like for users.

DESCRIPTION OF REFERENCE SIGNS

[0087]

100: User terminal

500: Server (information provision device)

511: Information acquisition unit

512: Communication control unit (transmission unit)

515: Shipping instruction unit

522: Trained learning device (first learning device)

529: Trained learning device (second learning device)

CLAIMS

1. An information provision device that is configured to connect to a user terminal of a user via a network and to provide information for improving a blood glucose level of the user, the device comprising:
 - a first learning device that has been trained to receive blood glucose level information about a blood glucose level of the user during a prescribed period, meal information about a meal taken by the user during the prescribed period, and action information about an action performed by the user during the prescribed period and to output recommendation information including at least one of a meal and improving agent for improving the blood glucose level of the user;
 - an information acquisition unit configured to receive input information input to the first learning device; and
 - a transmission unit configured to transmit the recommendation information output from the first learning device to the user terminal.
2. The information provision device according to claim 1, wherein the first learning device is further trained to output the recommendation information including an action for improving a blood glucose level.
3. The information provision device according to claim 1 or 2, wherein the first learning device is further trained to receive physical information about the user.
4. The information provision device according to any one of claims 1 to 3, wherein the first learning device is further trained to receive intestinal flora information about the user.

5. The information provision device according to any one of claims 1 to 4, further comprising a shipping instruction unit configured to instruct the user to ship the improving agent.

6. The information provision device according to any one of claims 1 to 5, further comprising a correction unit configured to corrects an output result from the first learning device and to output the recommendation information.

7. The information provision device according to any one of claims 1 to 6, further comprising

a second learning device that has been trained to receive physical information about the user, past blood glucose level information about a blood glucose level of the user measured before the prescribed period, and the meal information and to output the blood glucose level information,

wherein the information acquisition unit is configured to receive the blood glucose level information output from the second learning device.

8. An information provision system, comprising:
the information provision device according to any one of claims 1 to 7; and
at least the one user terminal.

9. An information provision method for providing information for improving a blood glucose level of a user in an information provision device connected to a user terminal of the user via a network, the method comprising:

receiving information to be input to a first learning device that has been trained to receive blood glucose level information about a blood glucose level of the user during a prescribed period, meal information about a meal taken by the user during the prescribed period, and action information about an action performed by the user during the prescribed period and to output recommendation information including at least one of a meal and improving agent for improving the blood glucose level of the user;

outputting the recommendation information from the first learning device; and
transmitting the recommendation information to the user terminal.

10. An information provision program for providing information for improving a blood glucose level of a user in an information provision device connected to a user terminal of the user via a network, the program comprising:

causing a computer of the information provision device to receive information to be input to a first learning device that has been trained to receive blood glucose level information about a blood glucose level of the user during a prescribed period, meal information about a meal taken by the user during the prescribed period, and action information about an action performed by the user during the prescribed period and to output recommendation information including at least one of a meal and improving agent for improving the blood glucose level of the user;

causing the computer to output the recommendation information from the first learning device; and

causing the computer to transmit the recommendation information to the user terminal.