

METHOD AND APPARATUS FOR HEALTH REMINDER, COMPUTER DEVICE, AND STORAGE MEDIUM

CROSS-REFERENCE TO RELATED APPLICATION(S)

[1] This application claims priority to Chinese Patent Application No. 201910174003.X, filed on March 8, 2019, and entitled “METHOD AND APPARATUS FOR HEALTH REMINDER, COMPUTER DEVICE, AND STORAGE MEDIUM”, the entire disclosure of which is hereby incorporated by reference in its entirety.

TECHNICAL FIELD

[2] This disclosure relates to the technical field of medical, and particularly to a method and apparatus for health reminder, a computer device, and a storage medium.

BACKGROUND

[3] Due to the acceleration of social aging and urbanization, and unhealthy lifestyles of people, the prevalence of diseases such as cardio-cerebrovascular disease is increasing, showing a rapid growth and individual aggregation trend in the younger and lower income groups. Most patients are already sick at the time of discovery. However, there is a lack of effective and timely comprehensive monitoring for the diseases. Although related devices, such as smart wearable devices, can monitor physiological characteristics of users, they merely measure and analyze the physiological characteristics of the user one by one, and feed back an analysis result corresponding to the single physiological characteristics to the user, but they cannot conduct comprehensive analysis and processing for the various physiological characteristics, such that the processing result is not accurate.

SUMMARY

[4] Implementations of the disclosure provide a method and apparatus for health reminder, a computer device, and a storage medium, which can conduct comprehensive analysis and processing.

[5] According to a first aspect, a computer device is provided. The computer device includes a memory and a processor. The memory is configured to store computer programs which, when executed by the processor, cause the processor to: obtain health data information and behavior habit information of a user; input the health data information and the behavior

habit information into a neural network model for analysis, to obtain a disease type associated with the user and a first association degree between the user and the disease type; select a feature comparison model corresponding to the disease type when the first association degree is greater than a preset threshold; input the health data information and the behavior habit information into the feature comparison model for analysis to obtain a second association degree between the user and the disease type; select, according to the second association degree, preset health notice information to remind the user.

[6] According to a second aspect, an apparatus for health reminder is provided. The apparatus includes an obtaining module, a first analyzing module, a first selecting module, a second analyzing module, and a second selecting module. The obtaining module is configured to obtain health data information and behavior habit information of a user. The first analyzing module is configured to input the health data information and the behavior habit information into a neural network model for analysis, to obtain a disease type associated with the user and a first association degree between the user and the disease type. The first selecting module is configured to select a feature comparison model corresponding to the disease type when the first association degree is greater than a preset threshold. The second analyzing module is configured to input the health data information and the behavior habit information into the feature comparison model for analysis, to obtain a second association degree between the user and the disease type. The second selecting module is configured to select, according to the second association degree, preset health notice information to remind the user.

[7] According to a third aspect, a computer readable storage medium is provided. The computer readable storage medium storing computer programs which, when executed by a processor, are operable with the processor to: obtain health data information and behavior habit information of a user; input the health data information and the behavior habit information into a neural network model for analysis, to obtain a disease type associated with the user and a first association degree between the user and the disease type; select a feature comparison model corresponding to the disease type when the first association degree is greater than a preset threshold; input the health data information and the behavior habit information into the feature comparison model for analysis, to obtain a second association degree between the user and the disease type; select, according to the second association degree, preset health notice information to remind the user.

[8] According to a fourth aspect, a method for health reminder is provided. The method includes the following. Health data information and behavior habit information of a

user are obtained. The health data information and the behavior habit information are input into a neural network model for analysis, to obtain a disease type associated with the user and a first association degree between the user and the disease type. When the first association degree is greater than a preset threshold, a feature comparison model corresponding to the disease type is selected. The health data information and the behavior habit information are input into the feature comparison model for analysis, to obtain a second association degree between the user and the disease type. According to the second association degree, preset health notice information is selected to remind the user.

[9] According to the computer device, the apparatus for health reminder, and the storage medium, the computer device includes the memory and the processor. The memory stores the computer programs. The computer programs, when executed by the processor, cause the processor to: obtain the health data information and the behavior habit information of the user; input the health data information and the behavior habit information into the neural network model for analysis, to obtain the disease type associated with the user and the first association degree between the user and the disease type; select the feature comparison model corresponding to the disease type when the first association degree is greater than the preset threshold; input the health data information and the behavior habit information into the feature comparison model for analysis, to obtain the second association degree between the user and the disease type; select, according to the second association degree, the preset health notice information to remind the user. In this way, the computer device can comprehensively analyze the health data information and the behavior habit information of the user, and select the preset health notice information for the user according to the analysis results, such that the user can know his/her own health status in time.

BRIEF DESCRIPTION OF THE DRAWINGS

[10] In order to describe technical solutions of implementations or the related art more clearly, the following will give a brief description of accompanying drawings used for describing the implementations or the related art. Apparently, the accompanying drawings described below merely illustrate some implementations. Those of ordinary skill in the art can also obtain other accompanying drawings based on the accompanying drawings described below without creative efforts.

[11] FIG. 1 is a schematic diagram illustrating a scenario to which a method for health reminder is applied according to implementations.

[12] FIG. 2 is a schematic structural diagram illustrating a computer device according

to implementations.

[13] FIG. 3 is a schematic flow chart illustrating a method for health reminder according to implementations.

[14] FIG. 4 is a schematic flow chart illustrating sub-operations in the method for health reminder illustrated in FIG. 2.

[15] FIG. 5 is a schematic flow chart illustrating a method for health reminder according to other implementations.

[16] FIG. 6 is a schematic flow chart illustrating sub-operations in the method for health reminder illustrated in FIG. 5.

[17] FIG. 7 is a schematic structural diagram illustrating an apparatus for health reminder according to implementations.

[18] FIG. 8 is a schematic structural diagram illustrating sub-modules of the apparatus for health reminder in FIG. 7.

[19] FIG. 9 is a schematic structural diagram illustrating sub-modules of the apparatus for health reminder in FIG. 7.

[20] FIG. 10 is a schematic structural diagram illustrating sub-modules of the apparatus for health reminder in FIG. 7.

DETAILED DESCRIPTION

[21] Technical solutions in the implementations of the disclosure will be described clearly and completely hereinafter with reference to the accompanying drawings in the implementations of the disclosure. Apparently, the described embodiments are merely some rather than all implementations of the disclosure. All other implementations obtained by those of ordinary skill in the art based on the implementations of the disclosure without creative efforts shall fall within the protection scope of the disclosure.

[22] The flowchart illustrated in the accompanying drawings is merely illustrative, and does not necessarily include all contents and operations/steps, nor does it have to be executed in the described order. For example, some operations/steps can also be decomposed, combined, or partially combined, and thus the actual execution order may be changed according to actual conditions.

[23] Implementations provide a method and apparatus for health reminder, a computer device, and a storage medium. The computer device, the apparatus for health reminder, and the storage medium can be applied in scenarios where health reminder is required. Examples of such scenarios may include homes, hospitals, community health service centers, physical

examination institutions, government disease prevention departments, or the like.

[24] The following describes some implementations in detail in conjunction with the accompanying drawings, and the following implementations and features in implementations may be combined with each other in the case of no confliction.

[25] FIG. 1 is a schematic diagram illustrating a scenario to which a method for health reminder is applied according to implementations. As illustrated in FIG. 1, a computer device 10, a server 20, a smart wearable device 30, and a smart terminal device 40 are communicated with each other. The computer device 10 may be other servers or terminals, and the smart wearable device 30 may be a smart bracelet or the like. The computer device 10 can obtain health data information and behavior habit information of a user which are stored by the server 20. The computer device 10 can also obtain health data information and behavior habit information of the user which are monitored by the smart wearable device 30. The smart wearable device 30 may be replaced with other terminal devices that can monitor the health data information of the user, which is not limited herein. After obtaining the health data information and the behavior habit information of the user from the server 20 or the smart wearable device 30 or the smart terminal device, the computer device 10 can remind the user of health according to the health data information obtained and the behavior habit information obtained.

[26] Referring to the application scenario illustrated in FIG. 1, the following gives a detailed description to the computer device 10 provided in implementations of the disclosure which is used for health reminder. As illustrated in FIG. 2, FIG. 2 is a schematic structural diagram illustrating a computer device according to implementations.

[27] As illustrated in FIG. 2, the computer device 10 includes a processor 101, a storage, and a network interface 103 which are coupled with each other via a system bus 105. The storage may include a non-transitory storage medium 1021 and a memory 1022. The non-transitory storage medium 1021 stores an operating system and a computer program. The computer program includes program instructions which, when executed by the processor 101, cause the processor 101 to implement prediction of “cardio-cerebrovascular disease”. The processor 101 is configured to provide computing and control capabilities to support the operation of the entire computer device. The memory 1022 provides an operating environment for the computer program in the non-transitory storage medium. When the computer program is executed by the processor, the computer program causes the processor 101 to implement health reminder. The network interface 103 may be used for network communication, such as sending of assigned tasks, and so on.

[28] Those skilled in the art can understand that FIG. 2 merely illustrates a partial structure of the computer device related to the solution of the disclosure, and does not constitute a limitation on the computer device to which the solution of the disclosure is applied. The computer device may include more or fewer components than illustrated, or may combine certain components, or may adopt different arrangements of components.

[29] It can be understood that the processor 101 may be a central processing unit (CPU), or may be other general-purpose processors, digital signal processors (DSP), application-specific integrated circuits (ASIC), field programmable gate arrays (FPGA), or other programmable logic devices, discrete gate or transistor logic devices, discrete hardware components, or the like. The general-purpose processor may be a microprocessor, any conventional processor, or the like.

[30] The processor 101 is configured to run computer programs stored in the memory to implement following operations of the method for health reminder. As illustrated in FIG. 3, FIG. 3 is a flow chart illustrating the method for health reminder realized by the processor 101 when the computer programs stored in the memory are run by the processor 101. The method begins at S101.

[31] At S101, health data information and behavior habit information of a user are obtained.

[32] In one example, the health data information of the user includes “age”, “gender”, “medical history”, “step counting”, “heart rate”, “pulse”, “blood pressure”, and other health information. The behavior habit information of the user includes smoking habits, drinking habits, eating habits, sleeping habits, exercise habits, and so on. In one example, the health data information of the user can be obtained in real time through a smart wearable device worn by the user, such as a smart bracelet, and the smart wearable device can upload the health data information of the user to the computer device 10 after obtaining the health data information. Alternatively, when the computer device 10 needs to obtain the health data information of the user, the computer device 10 may send to a server 20 a request to obtain the health data information of the user, such that the server 20 can send corresponding health data information of the user to the computer device 10. The server 20 can store in advance the health data information of the user obtained by the hospital or the physical examination center, the health data information of the user obtained by a home examination device, or the health data information of the user obtained through the smart wearable device.

[33] The behavior habit information of the user can be obtained from a related application (APP). For example, the exercise habits can be obtained through a sport related

application. The eating habits can be obtained through a diet related application, etc., or can be obtained by analyzing payment contents in the third-party payment system. The obtained behavior habit information of the user may or may not be sent to the computer device 10 actively. Alternatively, when the computer device 10 needs to obtain behavior habit information of the user, the computer device 10 can send a request to obtain behavior habit information of the user to the server 20 which pre-stores the behavior habit information of the user, such that the server 20 can send corresponding behavior habit information of the user to the computer device 10.

[34] At S102, the health data information and the behavior habit information are input into a neural network model for analysis, to obtain a disease type associated with the user and a first association degree between the user and the disease type.

[35] The neural network model is trained in advance. That is, health data information and behavior habit information of a large number of patients suffering from various diseases are input into a neural network for model training. The neural network includes a convolution layer, a nonlinear unit, a pooling layer, and a full connection layer. Feature maps are obtained through a convolution operation, and the feature maps are corrected by the nonlinear unit. A pooling operation is performed on the corrected feature maps to obtain dimension-reduced feature maps, where the pooling operation includes max pooling, average pooling, and sum pooling. Thereafter, the pooled feature maps are input into the full connection layer to be processed with an activation function, and then the disease type associated with the user and the first association degree between the user and the disease type are outputted from the neural network model. The disease type includes “cardio-cerebrovascular disease”, “tumors”, “gynecological disease”, or the like. The first association degree between the user and the disease type can be expressed as a percentage or expressed by other forms of numerical values. A filter of the convolutional layer is adjusted and updated according to error of output, until the error falls within a target range. With this, training of the convolutional neural network based prediction model for various types of disease is completed, and thus the trained neural network model can be obtained.

[36] The health data information and the behavior habit information (obtained at S101) are input into the neural network model for analysis, to obtain the disease type associated with the user and the first association degree between the user and the disease type. For example, with aid of the neural network model, it can be determined that the disease type associated with the user is “cardio-cerebrovascular disease” and the first association degree between the user and the “cardio-cerebrovascular disease” is 60%.

[37] At S103, a feature comparison model corresponding to the disease type is selected when the first association degree is greater than a preset threshold.

[38] In one example, when the first association degree (obtained at S102) between the user and the disease type is greater than the preset threshold, the feature comparison model corresponding to the disease type is selected to further assess the health status of the user. For example, in the example given above, the first association degree between the user and the “cardio-cerebrovascular disease” is 60%, and if the preset threshold is 50%, a feature comparison model corresponding to the “cardio-cerebrovascular disease” is selected. When the first association degree is greater than the preset threshold, it indicates that the user is highly associated with the disease type, and the user may be at a high risk of suffering from this type of disease, and thus it is necessary to further determine the diseases that the user is associated with and to what extent the user is associated with the diseases, that is, association degree. Therefore, when the first association degree is greater than the preset threshold, the feature comparison model corresponding to the disease type is selected to further analyze health status of the user.

[39] At S104, the health data information and the behavior habit information are input into the feature comparison model for analysis, to obtain a second association degree between the user and the disease type.

[40] According to implementations, the processor 101 is further configured to input the health data information and the behavior habit information into the feature comparison model for analysis, to obtain the second association degree between the user and the disease type, after selecting the feature comparison model corresponding to the disease type. In the example given above, a feature comparison model corresponding to the “cardio-cerebrovascular disease” is selected, and thus the processor 101 is configured to input the health data information and the behavior habit information into the feature comparison model corresponding to the “cardio-cerebrovascular disease”. In terms of inputting the health data information and the behavior habit information into the feature comparison model for analysis to obtain the second association degree between the user and the disease type, the processor 101 is configured to perform operations as illustrated in FIG. 4.

[41] In one example, as illustrated in FIG. 4, FIG. 4 is a schematic flow chart illustrating the health data information and the behavior habit information being input into the feature comparison model (selected at S103) for analysis to obtain the second association degree between the user and the disease type. The operation at S104 is implemented as operations at S1041 to S1044.

[42] At S1041, index information in the health data information is compared with pre-stored normal index information to determine abnormal index information in the health data information.

[43] In at least one implementation, the index information includes index items and feature values corresponding to the index items. In one example, the index items include “blood pressure”, “heart rate”, “total cholesterol”, “low-density lipoprotein cholesterol”, “serum triglyceride”, and so on. The feature value corresponding to each of the index items is a specific numerical value or a numerical range. For example, a feature value corresponding to the “blood pressure” is 90/60mmHg~130/90mmHg. Alternatively, the index item may also be presented in the form of an image, such as an electrocardiogram, a computed tomography (CT) image, and so on. In this case, a corresponding feature value may be image feature information. For instance, for a normal electrocardiogram, a duration of P wave is generally less than 0.12s, an amplitude the P wave is generally less than 0.25mV in limb lead, and an amplitude the P wave is generally less than 0.2mV in chest lead. As illustrated in Table 1, the normal index information is pre-stored in the computer device 10 in the form of a data table.

Table 1: Data table of normal index information

Index items	Blood pressure	Heart rate	Total cholesterol	Low-density lipoprotein cholesterol	...
Feature values	90/60mmHg ~ 130/90mmHg	60 ~ 100 times/minute	<120mg/dl	<150mg/dl	...

[44] The index information in the health data information of the user is compared with the pre-stored normal index information to determine the abnormal index information in the health data information. The index information in the health data information of the user also includes index items and feature values corresponding to the index items. For example, in the case that the index item in the index information in the health data information of the user is “blood pressure”, a feature value corresponding to the “blood pressure” (that is, blood pressure value) is 140/90mmHg, and thus index information corresponding to the “blood pressure” is determined to be the abnormal index information in the health data information. It can be understood that according to the index information in the health data information of the user, one or more abnormal index information may be determined.

[45] At S1042, an associated disease is determined according to index items in the

abnormal index information and a pre-stored disease type list.

[46] In one example, for the “cardio-cerebrovascular disease” described above, the pre-stored cardio-cerebrovascular disease type list is illustrated in Table 2. Table 2 illustrates multiple disease types of the “cardio-cerebrovascular disease” and various index information of each disease type. The index information includes index items and feature values corresponding to the index items. For example, index items and feature values corresponding to “hypertension” include: “age” and a corresponding age range, “weight” and a corresponding weight range, “hereditary history” and a feature value corresponding to the “hereditary history” (where “1” indicates that there is “hereditary history” and “0” indicates that there is no “hereditary history”), and so on.

Table 2: Cardio-cerebrovascular disease type list

Serial number	Disease type	Index information				
1	Hypertension	Blood pressure	Age	Weight	Hereditary history	...
		>140/90 mmHg	>40 years old	>160	1	...
2	Hyperlipoidemia	Total cholesterol	Low-density lipoprotein cholesterol	Serum triglyceride	High-density lipoprotein cholesterol	...
		>200mg/di	>120mg/di	>150mg/di	<35mg/di	...
...	...	...	...	...	...	...

[47] According to the index items of the abnormal index information and the pre-stored cardio-cerebrovascular disease type list, a corresponding type of “cardio-cerebrovascular disease” is determined. For example, if index items of the abnormal index information of the user are “blood pressure” and “total cholesterol”, according to the pre-stored cardio-cerebrovascular disease type list, a cardio-cerebrovascular disease type (an associated disease) that includes at least one of the two index items (i.e., the “blood pressure” and “total cholesterol”) is determined. As illustrated in Table 2, the cardio-cerebrovascular disease type that relates to the “blood pressure” is “hypertension”, and the cardio-cerebrovascular disease type that relates to the “total cholesterol” is “hyperlipoidemia”. In this way, a cardio-cerebrovascular disease associated with the user, that is, a specific type of the “cardio-cerebrovascular disease”, is determined.

[48] At S1043, feature values corresponding to the health data information and the behavior habit information are compared with pre-stored feature values corresponding to the associated disease, to obtain multiple comparison results.

[49] In one example, the processor 101 is further configured to compare the feature values corresponding to the health data information and the behavior habit information with the pre-stored feature values corresponding to the associated disease, to obtain the multiple comparison results, after the processor 101 determines at S1042 the cardio-cerebrovascular disease type that the user may suffer from.

[50] In one example, the feature values corresponding to the health data information and the behavior habit information of the user are marked as: $X_1, X_2, \dots, X_n$, each of which represents a numerical value of a corresponding health data information or behavior habit information. For example, X_1 represents the feature value corresponding to “age” which is 40 years old, X_2 represents the feature value corresponding to the “blood pressure” which is 140/90mmHg, and X_n represents no drinking, which can be represented by “0”. The pre-stored feature values corresponding to the health data information and the behavior habit information corresponding to the associated disease (such as “hypertension” or “hyperlipidemia”) are marked as: $Y_1, Y_2, \dots, Y_n$, each of which represents a numerical range. For example, Y_1 represents a corresponding age range which is greater than or equal to ($\geq$) 35 years old, Y_2 represents a corresponding blood pressure range which is greater than or equal to ($\geq$) 140/90mmHg, $\dots$, and Y_n represents a frequency of drinking which is greater than or equal to twice a day (≥ 2 times/day). Compare $X_1, X_2, \dots, X_n$ with $Y_1, Y_2, \dots, Y_n$ to obtain multiple comparison results, which are marked as $C_1, C_2, \dots, C_n$. If $X_i \in Y_i$, $C_i = 1$; otherwise, $C_i = 0$, where $1 \leq i \leq n$. As another example, if X_n represents no drinking (that is, $X_n = 0$), and Y_n represents a frequency of drinking which is greater than or equal to ($\geq$) 2 times/day, $C_n = 0$.

[51] At S1044, a second association degree between the user and the associated disease is determined according to the multiple comparison results.

[52] In at least one implementation, according to the multiple comparison results, calculate the second association degree between the user and the associated disease according to an association formula:

$$a_j = \frac{\lambda_1 C_1 + \lambda_2 C_2 + \dots + \lambda_n C_n}{n} = \frac{\sum_{i=1}^n \lambda_i C_i}{n}, \text{ where}$$

$C_i = \begin{cases} 1, & X_i \in Y_i \\ 0, & X_i \notin Y_i \end{cases}$ represents the multiple comparison results, a_j represents a second

association degree between the user and an associated disease j , n represents the number of the feature values, X_i represents the i^{th} feature value in the health data information and the behavior habit information, Y_i represents the pre-stored i^{th} feature value corresponding to the cardio-cerebrovascular disease type (that is, associated disease j), and λ_i represents a weight value of a comparison result C_i , where $0 \leq \lambda_i \leq 1$. λ_i can be determined according to degree of influence of the health data information and the behavior habit information on the cardio-cerebrovascular disease type. In this way, a comprehensive and specific analysis can be conducted on the health data information and the behavior habit information of the user to determine the association degree between the user and the associated disease.

[53] At S105, preset health notice information can be selected according to the second association degree to remind the user.

[54] In one example, the processor 101 is configured to select, according to the second association degree, preset health notice information to remind the user. As illustrated in Table 3, the preset health notice information can be stored in the form of a list, which includes associated diseases, second association degrees, and contents of the health notice information.

Table 3: Corresponding relationship between second association degrees and health notice information

Disease	Second association degree	Health notice information
Hypertension	>80%	High risk of hypertension, it is recommended to go to the hospital as soon as possible
Hypertension	60%~80%	Relatively high risk of hypertension, it is recommended to go to the hospital in time
Hypertension	50%~60%	Average risk of hypertension, physical examination is recommended, and please seek medical treatment in case of discomfort
Hypertension	<50%	Low risk of hypertension, pay attention to prevention
Hyperlipoidemia		
.....		

[55] For example, if the second association degree between the user and “hypertension” is 65%, health notice information “relatively high risk of hypertension, and it is recommended to go to the hospital in time

” can be selected from the above table. The computer device 10 may send the selected health notice information to the smart wearable device 30 and/or the smart terminal device 40 of the user. In one example, the computer device 10 may send the selected health notice information to the smart wearable device 30 and/or the smart terminal device 40 of the user via APP, email, short message, or the like. That is, various manners can be used for the health reminder, such as, voice reminders, text reminders, or the like. In addition, the computer device 10 can periodically send the selected health notice information to the user for a periodic reminder.

[56] According to implementations, the neural network model can be used to analyze the health data information and the behavior habit information of the user to obtain the disease type associated with the user and the first association degree between the user and the disease type, and then the feature comparison model corresponding to the disease type can be selected to further analyze the health data information and behavior habit information of the user to obtain a specific associated disease belongs to the above-mentioned disease type and the second association degree between the user and the associated disease. According to the second association degree, the health notice information may be generated for reminding the user. In this way, it is possible to obtain the association degree between the user and the associated disease by comprehensively analyzing the health data information and the behavior habit information of the user to remind the user in time, so that the user can know his/her own health status in time, and therefore prevention for the associated disease can be achieved.

[57] In at least one implementation, the processor of the computer device 10 runs computer programs stored in the memory to implement operations of the method for health reminder illustrated in FIG. 5. FIG. 5 is a schematic flow chart illustrating the method for health reminder implemented when the processor 101 runs the computer programs stored in the memory. As illustrated in FIG. 5, the method begins at S201.

[58] At S201, health data information and behavior habit information of a user are obtained.

[59] In one example, the health data information of the user includes “age”, “gender”, “medical history”, “step counting”, “heart rate”, “pulse”, “blood pressure”, and other health information, and the behavior habit information of the user includes smoking habits, drinking habits, eating habits, sleeping habits, exercise habits, and so on.

[60] In at least one implementation, in terms of obtaining the health data information and the behavior habit information of the user, the processor is configured to determine sampling time points or a sampling frequency according to at least one of current motion status or health status of the user, and obtain, according to the sampling time points or the sampling frequency, the health data information and the behavior habit information of the user.

[61] As one example, the sampling time points or the sampling frequency can be adjusted according to the current motion status of the user. For example, the smart terminal device 40 can determine whether the user is exercising according to exercise information obtained by a sport related application. If the user is exercising, the processor can obtain health data information and behavior habit information of the user during the exercise, as well as health data information and behavior habit information of the user half an hour after the exercise, so that information during and after the exercise can be compared and analyzed.

[62] As another example, when a certain index item of the health data information of the user monitored in real time by the smart wearable device 30 changes suddenly, it indicates that abnormal may occur to the health of the user, and in this case the sampling frequency may be increased. For instance, if there is a sudden change in the “heart rate” or “blood pressure”, increase the sampling frequency. Consider that an original sampling frequency is once a day, and when the health of the user is determined as abnormal, the sampling frequency can be increased to be three times a day, once an hour, or the like. Thereafter, the health data information and the behavior habit information of the user are obtained according to the increased sampling frequency, so that the health data information and the behavior habit information of the user can be obtained in real time according to the health status of the user, which can achieve the purpose of real-time monitoring and analysis.

[63] At S202, the health data information and the behavior habit information are input into a neural network model for analysis to obtain a disease type associated with the user and a first association degree between the user and the disease type.

[64] The health data information and the behavior habit information (obtained at S201) are input into a neural network model trained in advance, to obtain the disease type associated with the user and the first association degree between the user and the disease type. For example, with aid of the neural network model, it can be determined that the disease type associated with the user is “cardio-cerebrovascular disease” and the first association degree between the user and the “cardio-cerebrovascular disease” is 60%.

[65] At S203, a feature comparison model corresponding to the disease type is selected

when the first association degree is greater than a preset threshold.

[66] When the first association degree (obtained at S202) between the user and the disease type is greater than the preset threshold, the feature comparison model corresponding to the disease type is selected to further assess the health status of the user. For example, in the example given above, the first association degree between the user and the cardio-cerebrovascular disease is 60%, and if the preset threshold is 50%, a feature comparison model corresponding to the “cardio-cerebrovascular disease” is selected.

[67] At S204, the health data information and the behavior habit information are input into the feature comparison model for analysis, to obtain a second association degree between the user and the disease type.

[68] In one example, in terms of inputting the health data information and the behavior habit information into the feature comparison model for analysis to obtain a first probability that the user suffers from a corresponding type of “cardio-cerebrovascular disease”, the processor 101 is configured to perform operations as illustrated in FIG. 6. In one example, as illustrated in FIG. 6, FIG. 6 is a schematic flow chart illustrating the health data information and the behavior habit information being input into the feature comparison model for analysis to obtain the second association degree between the user and the disease type. The operation at S204 is implemented as operations at S2041 to S2045.

[69] At S2041, index information in the health data information is compared with pre-stored normal index information to determine abnormal index information in the health data information.

[70] At S2042, an associated disease is determined according to index items in the abnormal index information and a pre-stored disease type list.

[71] At S2043, feature values corresponding to the health data information and the behavior habit information are compared with pre-stored feature values corresponding to the associated disease, to obtain multiple comparison results.

[72] In one example, the feature values corresponding to the health data information and the behavior habit information are compared with the pre-stored feature values corresponding to the associated disease. If a feature value of the health data information and the behavior habit information falls into a feature value corresponding to the associated disease, a comparison result can be set to be 1; otherwise, the comparison result can be set to be 0.

[73] At S2044, a weight value of each of the multiple comparison results is determined according to degree of influence of the health data information and the behavior habit

information on the associated disease.

[74] In one example, there have multiple index items in the health data information and the behavior habit information. The multiple index items have different degrees of influence on the associated disease. For example, for “hypertension”, the “blood pressure” in the health data information has a greater influence on the “hypertension” than other index items, Therefore, when feature values of the “blood pressure” are compared, a weight value of a comparison result obtained can be set to be 0.8, and a weight value of each of comparison results of other index items can be set to be 0, 0.2, or the like. The weight value is greater than or equal to 0 and less than or equal to 1.

[75] At S2045, a second association degree between the user and the associated disease is determined according to the multiple comparison results.

[76] In at least one implementation, according to the multiple comparison results, calculate the second association degree between the user and the associated disease according to an association formula:

$$a_j = \frac{\lambda_1 C_1 + \lambda_2 C_2 + \dots + \lambda_n C_n}{n} = \frac{\sum_{i=1}^n \lambda_i C_i}{n}, \text{ where}$$

$C_i = \begin{cases} 1, & X_i \in Y_i \\ 0, & X_i \notin Y_i \end{cases}$ represents the multiple comparison results, a_j represents a second association degree between the user and an associated disease j , n represents the number of the feature values, X_i represents the i^{th} feature value in the health data information and the behavior habit information, Y_i represents the pre-stored i^{th} feature value corresponding to the cardio-cerebrovascular disease type, and λ_i represents a weight value of a comparison result C_i , where $0 \leq \lambda_i \leq 1$. λ_i (which represents the weight value of the comparison result C_i) can be determined according to degree of influence of the health data information and the behavior habit information on the cardio-cerebrovascular disease type. In this way, a comprehensive and specific analysis can be conducted on the health data information and the behavior habit information of the user to determine the association degree between the user and the associated disease.

[77] At S205, a disease risk is determined according to the second association degree.

[78] In one example, if the second association degree is greater than 80%, it can be determined that the user may be at a high risk for the associated disease. The disease risk can be classified according to different degrees of risk as illustrated in Table 4.

Table 4: Correspondence relationship between second association degrees and disease risks

Second association degree	Disease risk
$a_i \geq 80\%$	High risk
$60\% \leq a_i < 80\%$	Relatively high risk
$50\% \leq a_i < 60\%$	Average risk
$a_i < 50\%$	Low risk

[79] At S206, a predetermined health report is selected according to the disease risk, and the predetermined health report is sent to the user.

[80] The disease risks and the predetermined health reports are in one-to-one correspondence. As illustrated in Table 5, the predetermined health report is selected according to the disease risk.

Table 5: Correspondence relationship between disease risks and health reports

Disease	Disease risk	Health report
Hypertension	High risk	Health report 1 for hypertension
Hypertension	Relatively high risk	Health report 2 for hypertension
Hypertension	Average risk	Health report 3 for hypertension
.....		

[81] If the user may be at a relatively high risk for “hypertension”, “health report 2 for hypertension” is selected. In one example, in the health report, risk factors that affect the prediction results may be described to inform the user. For example, the heart rate is 140bpm, which is a main factor leading to “myocardial infarction” and “coronary heart disease”. For another example, if the heart rate is normal (60~100 bpm), the risk of “myocardial infarction” and “coronary heart disease” may be reduced, such that it can be recommended to adjust the heart rate by seeking medical advice or other means.

[82] The computer device 10 may send the predetermined health report selected to the smart wearable device 30 and/or the smart terminal device 40 of the user, to remind the user in time. In addition, the user can also see the predetermined health report at any time.

[83] At S207, the predetermined health report is modified according to the behavior habit information of the user, and the predetermined health report modified is sent to the user.

[84] In one example, after the predetermined health report is selected, in order to improve the predetermined health report, the predetermined health report can be modified

according to the behavior habit information of the user, for reminding the user of matters (such as living habits, eating habits, exercise habits, etc.) that need to pay attention to. Thereafter, the predetermined health report modified may be sent to the user, such that after receiving the predetermined health report modified, the user can as required pay attention to living habits, eating habits, exercise habits, and so on, to reduce the disease risk, thereby achieving effective prevention.

[85] An apparatus for health reminder is provided. FIG. 7 is a schematic structural diagram illustrating an apparatus 50 for health reminder according to implementations. The apparatus 50 is configured to implement any of the methods described in the above. The apparatus 50 can be applied in a server or a terminal. The server may be an independent server or a server cluster. The terminal may be a mobile phone, a tablet computer, a notebook computer, a desktop computer, a personal digital assistant, a wearable device, or other electronic devices. As illustrated in FIG. 7, the apparatus 50 includes an obtaining module 51, a first analyzing module 52, a first selecting module 53, a second analyzing module 54, and a second selecting module 55.

[86] The obtaining module 51 is configured to obtain health data information and behavior habit information of a user. The first analyzing module 52 is configured to input the health data information and the behavior habit information into a neural network model for analysis to obtain a disease type associated with the user and a first association degree between the user and the disease type. The first selecting module 53 is configured to select a feature comparison model corresponding to the disease type when the first association degree is greater than a preset threshold. The second analyzing module 54 is configured to input the health data information and the behavior habit information into the feature comparison model for analysis, to obtain a second association degree between the user and the disease type. The second selecting module 55 is configured to select, according to the second association degree, preset health notice information to remind the user.

[87] As illustrated in FIG. 8, in at least one implementation, the second analyzing module 54 further includes a first comparing sub-module 541, a first determining sub-module 542, a second comparing sub-module 543, and a first calculating sub-module 544. The first comparing sub-module 541 is configured to compare index information in the health data information with pre-stored normal index information, to determine abnormal index information in the health data information, where the index information includes index items and feature values corresponding to the index items. The first determining sub-module 542 is configured to determine, according to index items in the abnormal index information and a

pre-stored disease type list, an associated disease. The second comparing sub-module 543 is configured to compare feature values corresponding to the health data information and the behavior habit information with pre-stored feature values corresponding to the associated disease, to obtain multiple comparison results. The first calculating sub-module 544 is configured to determine a second association degree between the user and the associated disease according to the multiple comparison results.

[88] The first calculating sub-module 544 further includes a calculating sub-unit 5441 configured to according to the multiple comparison results, calculate the second association degree between the user and the associated disease according to an association formula:

$$a_j = \frac{\lambda_1 C_1 + \lambda_2 C_2 + \dots + \lambda_n C_n}{n} = \frac{\sum_{i=1}^n \lambda_i C_i}{n}, \text{ where}$$

$C_i = \begin{cases} 1, & X_i \in Y_i \\ 0, & X_i \notin Y_i \end{cases}$ represents the multiple comparison results, a_j represents a second

association degree between the user and an associated disease j , n represents the number of the feature values, X_i represents the i^{th} feature value in the health data information and the behavior habit information, Y_i represents the pre-stored i^{th} feature value corresponding to the associated disease j , and λ_i represents a weight value of a comparison result C_i , where $0 \leq \lambda_i \leq 1$.

[89] In at least one implementation, the second analyzing module 54 further includes a second determining sub-module 545. The second determining sub-module 545 is configured to determine a weight value of each of the multiple comparison results according to degree of influence of the health data information and the behavior habit information on the associated disease.

[90] FIG. 9 is a schematic structural diagram illustrating the second selecting module 55. The second selecting module 55 further includes a third determining sub-module 551 and a first selecting sub-module 552. The third determining sub-module 551 is configured to determine a disease risk according to the second association degree. The first selecting sub-module 552 is configured to select, according to the disease risk, a predetermined health report, and send the predetermined health report to the user.

[91] In one example, the second selecting module 55 further includes a modifying module 553. The modifying module 553 is configured to modify the predetermined health report according to the behavior habit information of the user.

[92] FIG. 10 is a schematic structural diagram illustrating the obtaining module 51. In

one example, the obtaining module 51 further includes a fourth determining sub-module 511 and an obtaining sub-module 512. The fourth determining sub-module 511 is configured to determine sampling time points or a sampling frequency according to at least one of current motion status or health status of the user. The obtaining sub-module 512 is configured to obtain, according to the sampling time points or the sampling frequency, the health data information and the behavior habit information of the user.

[93] It should be noted that those skilled in the art can clearly understand that for the convenience and brevity of the description, for the specific working process of the apparatus for health reminder described above, reference may be made to the corresponding process in the foregoing computer device implementations, and details are not described herein again.

[94] Implementations of the disclosure also provide a computer readable storage medium. The computer readable storage medium stores computer programs, the computer programs include program instructions, and the processor executes the program instructions to implement the method for health reminder provided in the above implementations.

[95] The computer readable storage medium may be an internal storage unit of the computer device described in the foregoing implementations, such as the hard disk or memory of the computer device. The computer readable storage medium may also be an external storage device of the computer device, such as a plug-in hard disk, a smart memory card (SMC), and a secure digital (SD) card, a flash Card, and so on, which are equipped on the computer device.

[96] The foregoing merely describes some implementations of the disclosure, but the protection scope of the disclosure is not limited thereto. Those skilled in the art can easily think of various equivalent modifications or substitutions within the technical scope disclosed in the disclosure, and these modifications or substitutions should be covered by the protection scope of the disclosure. Therefore, the protection scope of the disclosure should be subject to the protection scope of the claims.

What is claimed is:

1. A computer device, comprising:

a processor; and

a memory configured to store computer programs which, when executed by the processor, cause the processor to:

obtain health data information and behavior habit information of a user;

input the health data information and the behavior habit information into a neural network model for analysis, to obtain a disease type associated with the user and a first association degree between the user and the disease type;

select a feature comparison model corresponding to the disease type when the first association degree is greater than a preset threshold;

compare index information in the health data information with pre-stored normal index information to determine abnormal index information in the health data information, wherein the index information comprises index items and feature values corresponding to the index items;

determine, according to index items in the abnormal index information and a pre-stored disease type list, an associated disease;

compare feature values corresponding to the health data information and the behavior habit information with pre-stored feature values corresponding to the associated disease, to obtain a plurality of comparison results;

according to the plurality of comparison results, calculate a second association degree between the user and the associated disease according to an association formula:

$$a_j = \frac{\lambda_1 C_1 + \lambda_2 C_2 + \dots + \lambda_n C_n}{n} = \frac{\sum_{i=1}^n \lambda_i C_i}{n}, \text{ wherein}$$

$$C_i = \begin{cases} 1, & X_i \in Y_i \\ 0, & X_i \notin Y_i \end{cases} \text{ represents the plurality of comparison results, } a_j \text{ represents a}$$

second association degree between the user and an associated disease j , n represents the number of the feature values, X_i represents the i^{th} feature value in the health data information and the behavior habit information, Y_i represents the pre-stored i^{th} feature value corresponding to the associated disease j , and λ_i represents a weight value of a comparison result C_i , wherein $0 \leq \lambda_i \leq 1$; and

select, according to the second association degree, preset health notice information to

remind the user.

2. The computer device of claim 1, wherein the processor configured to obtain the health data information and the behavior habit information of the user is configured to:

determine sampling time points or a sampling frequency according to at least one of current motion status or health status of the user; and

obtain, according to the sampling time points or the sampling frequency, the health data information and the behavior habit information of the user.

3. The computer device of claim 1, wherein the processor is further configured to:

prior to according to the plurality of comparison results, calculating the second association degree between the user and the associated disease according to the association formula,

determine a weight value of each of the plurality of comparison results according to degree of influence of the health data information and the behavior habit information on the associated disease.

4. The computer device of claim 1, wherein the processor configured to select, according to the second association degree, the preset health notice information to remind the user is configured to:

determine a disease risk according to the second association degree;

select, according to the disease risk, a predetermined health report; and

send the predetermined health report to the user.

5. The computer device of claim 4, wherein the processor is further configured to:

after selecting, according to the disease risk, the predetermined health report,

modify the predetermined health report according to the behavior habit information of the user.

6. An apparatus for health reminder, comprising:

an obtaining module configured to obtain health data information and behavior habit information of a user;

a first analyzing module configured to input the health data information and the behavior habit information into a neural network model for analysis to obtain a disease type

associated with the user and a first association degree between the user and the disease type;

a first selecting module configured to select a feature comparison model corresponding to the disease type when the first association degree is greater than a preset threshold;

a second analyzing module configured to:

compare index information in the health data information with pre-stored normal index information to determine abnormal index information in the health data information, wherein the index information comprises index items and feature values corresponding to the index items;

determine, according to index items in the abnormal index information and a pre-stored disease type list, an associated disease;

compare feature values corresponding to the health data information and the behavior habit information with pre-stored feature values corresponding to the associated disease, to obtain a plurality of comparison results; and

according to the plurality of comparison results, calculate a second association degree between the user and the associated disease according to an association

$$\text{formula: } a_j = \frac{\lambda_1 C_1 + \lambda_2 C_2 + \dots + \lambda_n C_n}{n} = \frac{\sum_{i=1}^n \lambda_i C_i}{n}, \text{ wherein}$$

$$C_i = \begin{cases} 1, & X_i \in Y_i \\ 0, & X_i \notin Y_i \end{cases} \text{ represents the plurality of comparison results, } a_j \text{ represents a}$$

second association degree between the user and an associated disease j , n represents the number of the feature values, X_i represents the i^{th} feature value in the health data information and the behavior habit information, Y_i represents the pre-stored i^{th} feature value corresponding to the associated disease j , and λ_i represents a weight value of a comparison result C_i , wherein $0 \leq \lambda_i \leq 1$; and

a second selecting module configured to select, according to the second association degree, preset health notice information to remind the user.

7. The apparatus of claim 6, wherein the obtaining module configured to obtain the health data information and the behavior habit information of the user is configured to:

determine sampling time points or a sampling frequency according to at least one of current motion status or health status of the user; and

obtain, according to the sampling time points or the sampling frequency, the health data information and the behavior habit information of the user.

8. The apparatus of claim 6, wherein the second selecting module is further configured to:

determine a weight value of each of the plurality of comparison results according to degree of influence of the health data information and the behavior habit information on the associated disease.

9. The apparatus of claim 6, wherein the second selecting module configured to select, according to the second association degree, the preset health notice information to remind the user is configured to:

determine a disease risk according to the second association degree;
select, according to the disease risk, a predetermined health report; and
send the predetermined health report to the user.

10. The apparatus of claim 9, further comprising:

a modifying module configured to modify the predetermined health report according to the behavior habit information of the user.

11. A computer readable storage medium storing computer programs which, when executed by a processor, are operable with the processor to:

obtain health data information and behavior habit information of a user;

input the health data information and the behavior habit information into a neural network model for analysis to obtain a disease type associated with the user and a first association degree between the user and the disease type;

select a feature comparison model corresponding to the disease type when the first association degree is greater than a preset threshold;

compare index information in the health data information with pre-stored normal index information to determine abnormal index information in the health data information, wherein the index information comprises index items and feature values corresponding to the index items;

determine, according to index item in the abnormal index information and a pre-stored disease type list, an associated disease;

compare feature values corresponding to the health data information and the behavior habit information with pre-stored feature values corresponding to the associated disease, to obtain a plurality of comparison results;

according to the plurality of comparison results, calculate a second association degree between the user and the associated disease according to an association formula:

$$a_j = \frac{\lambda_1 C_1 + \lambda_2 C_2 + \dots + \lambda_n C_n}{n} = \frac{\sum_{i=1}^n \lambda_i C_i}{n}, \text{ wherein}$$

$$C_i = \begin{cases} 1, & X_i \in Y_i \\ 0, & X_i \notin Y_i \end{cases} \text{ represents the plurality of comparison results, } a_j \text{ represents a}$$

second association degree between the user and an associated disease j , n represents the number of the feature values, X_i represents the i^{th} feature value in the health data information and the behavior habit information, Y_i represents the pre-stored i^{th} feature value corresponding to the associated disease j , and λ_i represents a weight value of a comparison result C_i , wherein $0 \leq \lambda_i \leq 1$; and

select, according to the second association degree, preset health notice information to remind the user.

12. The computer readable storage medium of claim 11, wherein the computer programs operable with the processor to obtain the health data information and the behavior habit information of the user are operable with the processor to:

determine sampling time points or a sampling frequency according to at least one of current motion status or health status of the user; and

obtain, according to the sampling time points or the sampling frequency, the health data information and the behavior habit information of the user.

13. The computer readable storage medium of claim 11, wherein the computer programs are further operable with the processor to:

prior to according to the plurality of comparison results, calculating the second association degree between the user and the associated disease according to the association formula,

determine a weight value of each of the plurality of comparison results according to degree of influence of the health data information and the behavior habit

information on the associated disease.

14. The computer readable storage medium of claim 11, wherein the computer programs operable with the processor to select, according to the second association degree, the preset health notice information to remind the user are operable with the processor to:

- determine a disease risk according to the second association degree;
- select, according to the disease risk, a predetermined health report; and
- send the predetermined health report to the user.

15. The computer readable storage medium of claim 14, wherein the computer programs are further operable with the processor to:

- after selecting, according to the disease risk, the predetermined health report,
 - modify the predetermined health report according to the behavior habit information of the user.

16. A method for health reminder, comprising:

- obtaining health data information and behavior habit information of a user;
- inputting the health data information and the behavior habit information into a neural network model for analysis to obtain a disease type associated with the user and a first association degree between the user and the disease type;

- selecting a feature comparison model corresponding to the disease type when the first association degree is greater than a preset threshold;

- comparing index information in the health data information with pre-stored normal index information to determine abnormal index information in the health data information, wherein the index information comprises index items and feature values corresponding to the index items;

- determining, according to index items in the abnormal index information and a pre-stored disease type list, an associated disease;

- comparing feature values corresponding to the health data information and the behavior habit information with pre-stored feature values corresponding to the associated disease, to obtain a plurality of comparison results;

- according to the plurality of comparison results, calculating a second association degree between the user and the associated disease according to an association formula: wherein the association formula is expressed as follows:

$$a_j = \frac{\lambda_1 C_1 + \lambda_2 C_2 + \dots + \lambda_n C_n}{n} = \frac{\sum_{i=1}^n \lambda_i C_i}{n}, \text{ and wherein}$$

$$C_i = \begin{cases} 1, & X_i \in Y_i \\ 0, & X_i \notin Y_i \end{cases}$$

represents the plurality of comparison results, a_j represents a

second association degree between the user and an associated disease j , n represents the number of the feature values, X_i represents the i^{th} feature value in the health data information and the behavior habit information, Y_i represents the pre-stored i^{th} feature value corresponding to the associated disease j , and λ_i represents a weight value of a comparison result C_i , wherein $0 \leq \lambda_i \leq 1$; and

selecting, according to the second association degree, preset health notice information to remind the user.

17. The method of claim 16, wherein obtaining the health data information and the behavior habit information of the user comprises:

determining sampling time points or a sampling frequency according to at least one of current motion status or health status of the user; and

obtaining, according to the sampling time points or the sampling frequency, the health data information and the behavior habit information of the user.

18. The method of claim 16, further comprising:

prior to according to the plurality of comparison results, calculating the second association degree between the user and the associated disease,

determining a weight value of each of the plurality of comparison results according to degree of influence of the health data information and the behavior habit information on the associated disease.

19. The method of claim 16, wherein selecting, according to the second association degree, the preset health prompting information to remind the user comprises:

determine a disease risk according to the second association degree;

select, according to the disease risk, a predetermined health report; and

send the predetermined health report to the user.

20. The method of claim 19, further comprising:
after selecting, according to the disease risk, the predetermined health report,
modify the predetermined health report according to the behavior habit
information of the user.