TEST Engineering & Management

July - August 2020
ISSN: 0193-4120 Page No. 5851 - 5861

Radio Frequency Perception Push of Personalized Consumption on Health Combining Collaborative Filtering Algorithm in Data Mining

Bo Wang

Nanyang Medical College, Henan, China,473000

Article Info
Volume 83
Page Number: 5851 - 5861
Publication Issue:
July - August 2020

Article History
Article Received: *25 April 2020*
Revised: *29 May 2020*
Accepted: *20 June 2020*
Publication: *28 August 2020*

Abstract

With the development of the Internet of Things (IoT) technology, concepts such as smart home, smart transportation, and smart medical care have emerged one after another, and people's lives are developing toward smarter and more personalized life. The continuous enrichment of sensor types has brought a variety of data. Hence, how to analyze and process these data effectively has become the key research direction in the industry. In this paper, the pre-processed health characteristic data and processes are used to obtain the service information recommendation for the users based on the collaborative filtering algorithm in data mining and push the health service and product consumption information suitable for the conditions of the users accordingly.
Keywords: *Internet of Things (IoT), Data Mining, Collaborative Filtering, Intelligent Push;*

Introduction

The new century is an era of comprehensive informatization and an era of information explosion when the informatization of society has become one of the most prominent symbols of the contemporary world [1-3]. With the rapid development and promotion of the Internet, computer, communication, and other technologies, the Internet of Things (IOT) is becoming an increasingly prominent and important technology and direction [4-6]. It is exactly due to the emergence and development of the IoT that a series of solutions such as "Smart earth" and smart home has been gradually put forward [7-8]. The characteristics of smart development are mainly reflected in the following aspects: (1) more thorough perception, where "more thorough" refers to the coverage beyond sensors, radio frequency identification, and so on; (2) more comprehensive interconnection and intercommunication, that is, the application of multiple forms of high-speed, high-bandwidth communication network tools; (3) deeper intelligence, which refers to the adoption of scientific methods for in-depth analysis of the data collected and solve the problems in a more novel and comprehensive way [9-12]. The medical system is not efficient at present, and the quality of services provided is not excellent. Hence, smart healthcare is also one of the crucial applications of the Internet of Things (IoT). In the face of cumbersome medical services and commodities, how can users choose and find the health services that are suitable for them? The interests and preferences of the users can be predicted by collecting and analyzing the purchase records, browsing history, and other relevant information of the customers and the commodities that may be of interest to the users can be pushed [12-16]. In this paper, the health characteristic data of users and their personal information collected in the

July - August 2020
ISSN: 0193-4120 Page No. 5851 - 5861

Internet of Things (IoT) are combined to analyze and obtain the health services and commodities needed by the users based on the collaborative filtering algorithm in data mining. Finally, the relevant results are pushed to the users actively.

1. Collaborative Filtering Recommendation Technology

Collaborative Filtering, also known as social filtering, was used for the first time in a paper entitled “Using Collaborative filtering to weave an information tapestry” by David Goldberg at Xerox PARC in 1992. Collaborative filtering recommendation technology is one of the leading technologies for the personalized recommendation in data mining. What is collaborative filtering recommendation technology? When we would like to learn about commodities, movies, music, and other information, the most common method is to consult friends who have similar tastes and hobbies to ours and decide whether we choose the types of commodities, movies, or music based on their recommendations. The collaborative filtering recommendation technology draws on the above concepts to provide recommendation results for the target user according to the evaluation of commodities or service information on the other users who have similar conditions to the target user when making decisions on the Internet information.

1.1. Health Characteristics of Users

In order to avoid the defects such as the sparsity of the collaborative filtering recommendation algorithm effectively and give full play to the advantages, we will introduce the health characteristic vectors of users to calculate the similarity among users in the system put forward in this paper. The characteristics of users include two aspects: on the one hand, the user manually enters and selects characteristic information through the system platform, including age, gender, body height, body weight, history of major diseases, family medical history, and so on. On the other hand, health data of users collected and transmitted to the system by the wireless sensor network includes blood pressure, body temperature, blood glucose, heart rate, and other information. According to the types of health conditions selected by the user, characteristic information related to the user is stored in the user database of the category. The similarity between the target user and the other users in the category database is calculated, and a set of similar nearest neighbor users is identified. Recommendations are made to the target user based on the commodities and services selected or purchased by the users in the set.

In the field of e-commerce where the collaborative filtering recommendation algorithm is most extensively applied, the input data for calculating the similarity among users is as the following in general: the user - item rating data model constructed based on the rating information of all users stored in the system database, as shown in Table 1 below:

Table 1. User – Item Rating Matrix

User	Item	Item 1	Item 2	Item 3	…	Item n
User 1	4	3	5	…	2	
User 2	4	4		…	5	
User 3	5	5		…		
…	…	…	…	…	…	
User m	4	4	4	…	4	

However, as mentioned in the previous sections, the user – item rating matrix has the problem of sparseness. In general, the scale of an e-commerce system is enormous, the number of commodities and services stored in the system is so huge that it can even far exceed the physical stores. Hence, it is highly difficult for users to give a rating to each item in the system. According to the data, the number of commodities purchased by general users only

Published by: The Mattingley Publishing Co., Inc.

July - August 2020
ISSN: 0193-4120 Page No. 5851 - 5861

accounts for 1% ~ 2% of the commodity items in the system. This ratio also applies to the proportion of commodities evaluated by users in the total number of commodity items in the system. Hence, users—item rating matrix is often highly sparse.

In the system put forward in this paper, we will use the personal health characteristics data of the users as the basis for the calculation of similarity. The health characteristics data of users include the following information: 1. the personal information manually entered in the system by users when they register and log in through the front-end platform, including the following information: gender, age, body height, body weight, whether they have suffered from major diseases, family medical history, and so on. 2. The wireless sensor network is used to collect the health characteristic data of users and store the data in their personal characteristic information database.

It is assumed that the health characteristics of each user are represented by an n-dimensional vector, and each dimension in the vector corresponds to a health characteristic of the user, then the health characteristic matrix of the user is an m×n order matrix. From Table 3.2, it can be known that the health characteristic vector of any user u can be expressed as the following: $\vec{u}=\{c_{u,1},c_{u,2},\cdots,c_{u,n}\}$. Among them, $c_{u,1}$ stands for the gender characteristics of the user, and “1” or “0” is taken as its value, where “1” indicates that the user is male, and “0” indicates that the user is female. $c_{u,2}$ stands for the age of the user, which is manually entered into the system by the user upon the registration. The “disease” characteristic system sets out a list of related diseases in advance, and the user selects the corresponding disease upon registration. “Blood pressure”, “Blood sugar”, “Heart rate” and other characteristics are collected by the wireless sensor network and then transmitted to the system platform.

1.2. Calculation of the Similarity

The collaborative filtering recommendation mechanism based on users is applied in the field of e-commerce. The basic recommendation concept is as the following: According to the ratings of commodities and services by users, if two users gave similar ratings to some commodities and services, it can be determined that the two users have similar tastes or preferences. Hence, it can be inferred that these two users will give similar ratings to other commodities and services. In general, the calculation methods to measure the similarity among different users include the following: cosine similarity calculation, modified cosine similarity calculation, correlation similarity calculation (Pearson correlation coefficient), Euclidean distance method, and so on.

It is assumed that the user - score matrix is shown in Table 3.3, in which $r_{m,n}$ stands for the rating of item n by user m. Then, the rating vector of user u can be expressed as the following: $\vec{u}=\{r_{u,1},r_{u,2},\cdots,r_{u,n}\}$, and the rating vector of user v can be expressed as the following: $\vec{v}=\{r_{v,1},r_{v,2},\cdots,r_{v,n}\}$.

(1) Cosine similarity

Based on this method for the similarity calculation, the basic idea [16] is as the following: The rating vector $\vec{u}=\{r_{u,1},r_{u,2},\cdots,r_{u,n}\}$ of any user u is an n-dimensional space vector, then the similarity between the corresponding two users can be obtained by calculating the angle between any two vectors. Under this calculation method, the range of similarity between the users is as the following: [-1,1]. When the value is 1, it indicates that the ratings of the two users are exactly the same; when the value is -1, it indicates that the ratings of the two users are completely opposite. It is assumed that the rating vector of user u is as the following: $\vec{u}=\{r_{u,1},r_{u,2},\cdots,r_{u,n}\}$, and the rating vector of user v is as the following: $\vec{v}=\{r_{v,1},r_{v,2},\cdots,r_{v,n}\}$, then the similarity sim (u,v) between them can be calculated based on Equation 1 as the following:

Published by: The Mattingley Publishing Co., Inc.

July - August 2020
ISSN: 0193-4120 Page No. 5851 - 5861

$$sim(u,v)=\cos(\vec{u},\vec{v})=\frac{\vec{u}\cdot\vec{v}}{\|\vec{u}\|\cdot\|\vec{v}\|}$$

(1)

(2) Modified cosine similarity

In this method for the calculation of user similarity, as the name implies [16], the defects of the cosine similarity method for calculating the similarity between users are corrected. In the cosine similarity method, the different scales when different users give ratings are not taken into consideration when calculating the similarity among the users. That is, although the full score is 5 points, some users are used to giving high scores close to 5 points, while other users are used to giving scores below 3 points. Hence, when this method is used to calculate the similarity among users, the user rating vector is first corrected where each element in the user rating vector is subtracted from the mean value of the user when the user rates all items. It is assumed that the set of items that user u and user v have jointly rated is as the following: $W_{u,v}=W_u \cap W_v$, in which W_u and W_v are the set of items that user u and user v have rated; the mean value $\overline{r_u}$ of ratings to all items by user u is the mean value $\overline{r_v}$ of ratings to all items by user v. The score value of any item is rated by user u is $r_{u,s}$, and the score value of any item is rated by user v is $r_{v,s}$; then, the similarity sim (u, v) between them can be calculated, as shown in Equation 2. The calculated range of the similarity values between the users is as the following: [-1,1]. When the value is 1, it indicates that the ratings by the two users are exactly the same; when the value is -1, it indicates that the ratings by the two users are completely opposite.

$$sim(u,v)=\frac{\sum_{s\in W_{u,v}}\left(r_{u,s}-\overline{r_u}\right)\cdot\left(r_{v,s}-\overline{r_v}\right)}{\sqrt{\sum_{s\in W_u}\left(r_{u,s}-\overline{r_u}\right)^2}\cdot\sqrt{\sum_{s\in W_v}\left(r_{v,s}-\overline{r_v}\right)^2}}$$

(2)

(3) Correlation similarity (Pearson correlation coefficient)

In this method, the Pearson correlation coefficient is used to measure the similarity among the users. It is assumed that the set of items that user u and user v have jointly rated is as the following: $W_{u,v}=W_u \cap W_v$, in which W_u and W_v are the sets of items that user u and user v have rated. The mean value of the ratings to all items by user u is $\overline{r_u}$, the mean value of the ratings to all items by user v is $\overline{r_v}$; the value of ratings to any item s by user u is $r_{u,s}$, the value of ratings to any item s by user v is $r_{v,s}$. Hence, the Pearson correlation coefficient is used to calculate the similarity between user u and user v, as shown in Equation 3. The calculation form of this equation is highly similar to that of the modified cosine similarity. The most significant difference lies in the denominator of these two equations. In the Pearson correlation coefficient, when the variance of user ratings is calculated based on the denominator, only the items in the set of items rated by user u and user v are calculated. However, in the modified cosine similarity, when the variance of the ratings of user u and user v is calculated, the variance of user u in the set of items that they have rated and the variance of user v in the set of items that they have rated are calculated separately, as shown below.

$$sim(u,v)=\frac{\sum_{s\in W_{u,v}}\left(r_{u,s}-\overline{r_u}\right)\cdot\left(r_{v,s}-\overline{r_v}\right)}{\sqrt{\sum_{s\in W_{u,v}}\left(r_{u,s}-\overline{r_u}\right)^2}\cdot\sqrt{\sum_{s\in W_{v,v}}\left(r_{v,s}-\overline{r_v}\right)^2}}$$

(3)

In several calculation methods introduced above, they aim at calculating the similarity between user ratings. In a general e-commerce system, the meaning and value range of the constituent elements of user rating vectors are stipulated in advance. If the system stipulates that only a positive integer less than or equal to 5 can be taken for the user rating, then the rating range for each commodity by the user can only be (0,5], for example, the rating vector to 5 commodities by user m is $\vec{m}=(3,5,2,3,4)$. In some cases, only two values of 0 or 1 can be taken for the user ratings as stipulated in the system. Then, the rating vector to 5 commodities by user n

Published by: The Mattingley Publishing Co., Inc.

July - August 2020
ISSN: 0193-4120 Page No. 5851 - 5861

is $\vec{m} = (1,0,0,1,1)$.

The health characteristic vector of user u is expressed as the following: $\vec{u} = \{c_{u,1}, c_{u,2}, \cdots, c_{u,n}\}$. Each element in the vector has a different meaning, represents different health characteristics, and has different measurement scales. The health characteristic vector representing user u in words is as the following: {gender, age, disease, body temperature, blood pressure, blood sugar...}. In this system, the value range of each element in the health characteristic vector of the users is as the following: The value for the "gender" element is "0" and "1". Where the value is "1", it indicates that the user is a male; where the value is "0", it indicates that the user is a female. The value for the "age" element is determined based on the real age of the user, the general value range is (0,100). When a user registers or completes personal information, the system will require the user to select the type of disease they suffer from. Hence, the value for the "disease" element is the number of the disease selected by the user; if the user suffers from no disease, "0" is selected. The values for "body temperature", "blood pressure", "blood glucose" and other elements are filled in based on user health data collected and transmitted to the platform through a wireless sensor network. Hence, if the health characteristic vector of the user is directly used for the calculation of similarity, different elements in the vector have different effects on the calculation results. Element items with a large value range may have a significant influence on the calculation result, while element items with a small value range may have little or no effect on the calculation result at all. Hence, the results obtained by directly calculating the similarity will have a large deviation. When the similarity of health characteristics between two users is calculated, each value for the health characteristic of the user will be pre-processed according to the different meanings of each element in the user's health characteristic vector so that the health characteristic vector conforms to our calculation requirements.

It is assumed that the health characteristic vector of user u is $\vec{u} = \{c_{u,1}, c_{u,2}, \cdots, c_{u,n}\}$. Before the similarity is calculated, the system will give a score to the value of each element in the health characteristic vector of the user. The blood pressure value is taken as an example. According to the relevant medical data, if the blood pressure value of the user u collected is as the following: (1) systolic blood pressure < 90mmHg, diastolic blood pressure < 60mmHg, the blood pressure value of the user is rated as "1"; (2) If 90mmHg ≤ systolic blood pressure < 140mmHg, 60mmHg ≤ diastolic blood pressure < 90mmHg, the blood pressure value of the user is rated as "2"; (3) If 140mmHg ≤ systolic blood pressure < 160mmHg, 90mmHg ≤ diastolic blood pressure < 100mmHg, the blood pressure value of the user is rated as "3"; (4) If 160mmHg ≤ systolic blood pressure < 180mmHg, 100mmHg ≤ diastolic blood pressure < 110mmHg, the blood pressure value of the user is rated as "4"; (5) If systolic blood pressure ≥ 180mmHg, diastolic blood pressure ≥ 110mmHg, the blood pressure value of the user is rated as "5". Similarly, for other health data of the user collected, we carry out the same rating preprocessing based on the medical data, so that each element range in the health characteristic vector of the user is between [1, 5].

Similarly, for the collected body temperature value of the user: (1) Where body temperature < 35°, the body temperature value of the user is rated as "1"; (2) Where 35° ≤ body temperature < 36.5°, the body temperature value of the user is rated as "2"; (3) Where 36.5° ≤ body temperature < 37.5°, the user's body temperature value is rated as "3"; (4) 37.5° ≤ body temperature < 38.5°, the user's body temperature value is rated as "4"; (5) body temperature ≥ 38.5°, the body temperature value of the user is rated as "5".

1.3. Selection of the nearest neighbor User Set

After the similarity between the target user and other stored users is calculated according to the

Published by: The Mattingley Publishing Co., Inc.

July - August 2020
ISSN: 0193-4120 Page No. 5851 - 5861

previous section, the next step is to determine the set of the nearest neighbor users who have similar health conditions to the target user. There are usually two methods for determining the set of the nearest neighbor users:

(1) Select the k users with the highest similarity. In this determination method, the similarity between users is sorted, and k users with the highest similarity are obtained according to the sorting results, that is, the set of the nearest neighbor users.

(2) All users whose similarity is greater than a certain threshold are selected. In this determination method, a threshold is set for the similarity between the users in advance. All users whose similarity obtained by calculation to the target user exceeds this threshold value are included in the set of the nearest neighbor users to the target user.

When the set threshold is used to determine the set of the nearest neighbor users, there is a problem in the selection of the threshold value. In this system, the health characteristics of users are complicated and changeable, and the health conditions of different users are different. If the threshold is not selected properly, it may lead to the result that the suitable set of the nearest neighbor users are not be selected: if the threshold value is excessively large, there may be no suitable nearest neighbor users available; if the threshold value is excessively small, there may be too many nearest neighbor users, which will increase the system overhead.

Sorting is carried out according to the similarity between the target user and other users stored, and the top k users in similarity are selected as the set of the nearest neighbor users to the target user according to the sorting result. In this study, 6 is taken as the value for k.

1.4. System Recommendation Algorithm

The user intelligent push system for personalized consumption on health based on data mining is designed to push to the registered users health services and commodities that are suitable for the users and provide personalized recommendations accordingly. In this section, "what to push" to target users is discussed. The input data includes two aspects. On the one hand, when registering or supplementing personal information, users fill in personal information, including age, gender, family disease history, etc., and select the disease they are suffering from or have suffered from in a series of disease lists provided by the system. On the other hand, the health characteristic data of the target user collected by the wireless sensor network includes body temperature value, blood pressure value, blood glucose value, heart rate value, and so on.

According to the types of diseases in the system selected by the users when they register or supplement personal information, the users are divided into different categories. The users who select high blood pressure are classified as high blood pressure. However, even if they suffer from the same type of disease, the characteristics of the conditions among different users will still be significantly different. Hence, the similarity between the target user and other users in the category to which it belongs is calculated. When the similarity between users is calculated, as described in the previous section, as different elements in the health characteristic vector of the user have different meanings and measurement scales, firstly, the health characteristic vector of the user must be preprocessed to obtain a new health characteristic vector of the user. The cosine similarity calculation method is used to calculate the new characteristic vectors to obtain the similarity between the target user and other users.

According to the calculation results, k users in the category with the most similar conditions to the target user are identified to constitute a set of the nearest neighbor users to the target user. In this system, we take 6 as the value for k. The health services and commodities selected by these 6 nearest neighbor users are read and compared with the health services and commodities previously selected by the target user. If the target user has already selected them, the item will be discarded. If the

Published by: The Mattingley Publishing Co., Inc.

target user has not selected it previously, the service and commodity are included in the list recommended for the target user. The commodities and services information in the list is enquired to see whether there is a specific gender item. If it exists, check whether the gender characteristics of the target user is compliant; if it is not compliant, the item is deleted from the recommendation list. Finally, the corresponding health services and commodities in the list are recommended to the users. The age difference between these users and the target user is calculated. The health services and commodities in the list are sorted according to the age difference in an ascending order and used as the information to be pushed to the target user. After the screening described above, if there are no more recommended items in the recommendation list, the nearest neighbor users to the target user are searched again.

2. Overall Design of Intelligent Radio Frequency Perception Push System for Personalized Consumption on Health

2.1. Structure of the Intelligent Radio Frequency Perception Push System for Personalized Consumption on Health

This system is deployed on the server and adopts the B/S three-tier architecture design, including a data layer, a function layer, and a presentation layer. Through the layered design, each layer only needs to implement the functions of this layer and the functions provided for the other layers, and the layers are independent of each other.

Presentation layer: It provides an interface for users to interact with the system. Users can register on the browser page, log in, browse health services, commodity information, view personal health characteristics information, view pushed services, commodity information, and so on.

Function layer: According to the personal information and collected health characteristics data of the user, the relevant algorithms of data mining are used for processing, and the appropriate health services and commodities are recommended to the user. After the user logs in to the system, the calculated recommendation result is pushed to the user browsing page.

Data layer: The system data layer mainly stores data information in the system. The data of the system includes the following: 1. Data related to the user, such as user name, login password, personal information filled in by the user upon registration, personal health characteristic data of the user collected by radio frequency, and health service and commodity information previously selected by the user. 2. Information related to health services and commodities. This type of information is mainly entered and maintained by the administrator at the background.

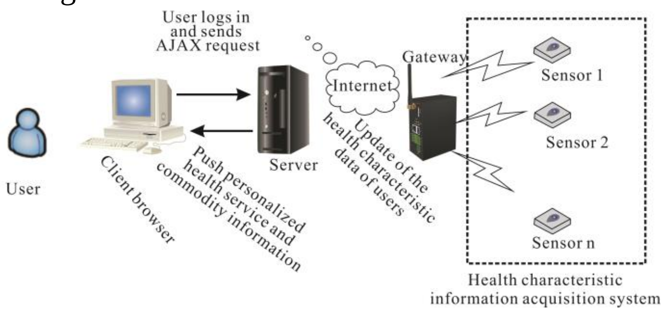

Figure 1. Network architecture diagram of the intelligent radio frequency perception push system for personalized consumption on health

As shown in Figure 1, it is a network architecture diagram of an intelligent radio frequency sensing push system for personalized consumption on health. In the system, mainly the concept of data mining is used to analyze and process the health characteristic data of the target users collected by the sensor terminal. Thus, a set of the nearest neighbor users who have similar health conditions to the target users can be obtained according to the health services and commodities previously selected by other users in the set and recommended to the target users. Finally, the calculated recommendation results are actively pushed from the server to the browsing interface of the users.

Published by: The Mattingley Publishing Co., Inc.

July - August 2020
ISSN: 0193-4120 Page No. 5851 - 5861

2.2. Overall Design of the Intelligent Radio Frequency Perception Push System for Personalized Consumption on Health

The intelligent push system for personalized consumption on health includes the following: user information subsystem, health characteristic acquisition subsystem, data mining subsystem, intelligent push subsystem, and background management subsystem. Figure 2 shows the functional module diagram of the system.

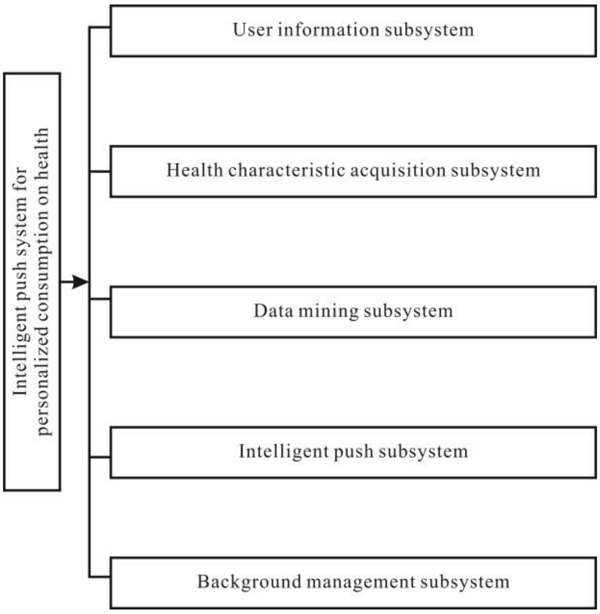

Figure 2. Functional module diagram of the intelligent radio frequency perception push system for personalized consumption on health

User information subsystem: Users register through the browser interface, and log in to the system through the user name and password. The user information subsystem stores the personal account information, health characteristic information, selected health service information, and other information of the user.

Health characteristic acquisition subsystem: This subsystem is composed of wireless radio frequency sensing nodes. The health characteristic data of the users collected include blood pressure, blood sugar, heart rate, and so on. In addition, the collected information is transmitted to the system platform.

Data mining subsystem: The relevant algorithms in data mining is applied to this subsystem to analyze and process the personal information and collected health characteristic data of the users to generate service and commodity information recommended for the users.

Intelligent push subsystem: When a user logs in to the system and browses the system pages, the subsystem pushes the health service and commodity information recommended by the server for the user to the browser interface.

Background management subsystem: The administrator maintains and manages the system through this subsystem, publishes and maintains relevant health services, commodities, and other information.

2.3. Process Design of the Intelligent Push System for Personalized Consumption on Health

After the user logs in to the system, the client sends an AJAX request to the server. At this time, there is no health service or commodity information recommended for the user in the server, and the server is temporarily blocking the connection. The server reads the personal health data information of the user. If the health characteristic data of the user are in the database, the information of the user is analyzed and processed based on the concept of collaborative filtering to obtain the health service and commodity information recommended to the user. Subsequently, the result is returned to the client and pushed to the page browsed by the user. Where the server reads the personal health data information of the user and finds that the wireless sensor terminal has not collected the user's information, it pushes the frequently selected health services and commodities of other users as recommendation results to the user.

3. Implementation of the Intelligent Radio Frequency Perception Push System for Personalized Consumption on Health

The intelligent push system for user personalized

Published by: The Mattingley Publishing Co., Inc.

July - August 2020
ISSN: 0193-4120 Page No. 5851 - 5861

consumption on health based on data mining is implemented in the MyEclipse development environment by Java programming, where the database is MySQL, and the Tomcat server is used as the serve. The server interacts with the database to push the recommendation results to the browsing page of the user. The health characteristic data of the users are collected through the wireless radio frequency sensor network.

The users interact with the system through the browser interface. Users are required to register an account in the system before they can obtain further push information. The account and password set at the time of the registration are the unique identifiers for the subsequent login of the user to the system. The system authorizes the user to log in by verifying the consistency of the account and password entered by the user.

Upon registration, the users need to fill in personal information such as age, gender, height, weight, etc. according to the system requirements, confirm whether they have any diseases, and select the corresponding types of diseases according to the system prompts. The system divides users into the corresponding user groups for further recommendation calculation according to the categories selected by users.

After the registration of an account with the system, the user logs in to the system according to the account number and password. It is required that the account and password entered when the user logs in should be the same as the account and password set upon registration, otherwise, the system will issue an error signal, and the user cannot log in to the system. The code for user login verification login is as the following:

```
String username = request.getParameter(“username”)
String password = request.getParameter(“password”)
UserDao dao = new UserDao();
User user = dao.find (String username. String password);
if (user ==null){
    //throw new RuntimeException (“User name cannot be empty”);
    request.setAttribute(“message”, “Incorrect user name or password”);
    request.setRequestDisputer(“/message.jsp”).
forward(request,. response);
}
request.setAttribute(“Welcome”);
request.setRequestDisputer(“/message.jsp”).
forward(request,. response);
```

The health characteristic data of the users are collected through the wireless sensor network. After the users log in to the system, the system stores the transmitted health characteristic data in the personal database of the users. Users can view their own health characteristics data through the front-end page of the system. Each terminal transmits the collected health characteristic data of the users to the system platform through the wireless gateway.

The implementation of the intelligent push system for personalized consumption on health includes the following aspects: “What to push” and “How to push”.

“What to push”: The system put forward in this paper applies the concept of collaborative filtering to analyze and process the health characteristic data of users collected and the personal information filled in upon user registration to identify a set of the nearest neighbor users who have similar health characteristics to the target user. According to the health service and commodity information selected by the user in the nearest neighbor user set and combined with the previous choices of the target user, the health service and commodity information to be pushed to the user is obtained.

“How to push”: How the system pushes the recommendation results obtained through the analysis and calculation based on collaborative filtering to the browsing page of users. In the system described in this paper, the recommended health service and commodity information will be actively pushed to the user's browsing page based on the

Published by: The Mattingley Publishing Co., Inc.

AJAX long polling method only when the recommendation results are calculated in the server. Figure 3 shows the flow chart of the system push.

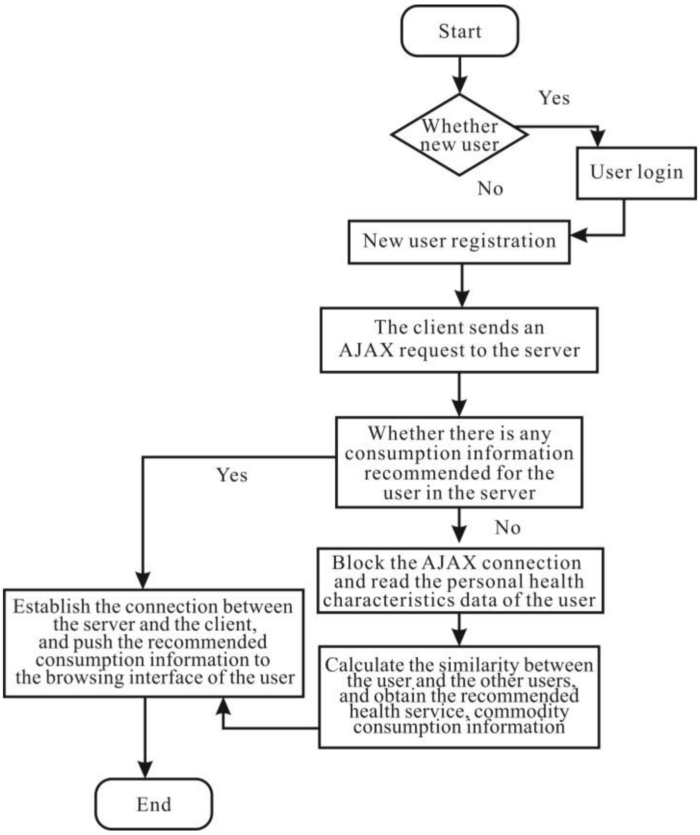

Figure 3. System push process

"You may need" is the health service and commodity information pushed by the system to the users. Based on the collected health characteristic data on the user, the system applies the concept of collaborative filtering to identify a set of similar nearest neighbor users. Finally, the system obtains the health service and commodity information to be pushed to the user. When the user mj browses the system page, the recommendation result is pushed to the user. If the users do not log in to the system, no personalized health service and commodity information will be pushed to them.

4. Conclusions

In the big picture of the development of the Internet of Things (IoT), through the use of wireless sensor networks to collect health data of users and the processing of the data based on the collaborative filtering algorithm in data mining at the same time, it has fully solved the "what to push" issue. According to the results of data analysis, the service information recommended for the user is obtained. At the same time, the system recommendation algorithm is used to push to the users the health service and product consumption information suitable for the conditions of the user accordingly. The issue of "how to push" is also taken into account. On the one hand, it can provide reasonable suggestions and support for users to make decisions; on the other hand, it has also improved the sales performance of commodities and services.

References

1. Sheth A , Jaimini U , Yip H Y . How Will the Internet of Things Enable Augmented Personalized Health?[J]. IEEE Intelligent Systems, 2018, 33(1):89-97.
2. Linde A A A V D , Herwaarden A E V , Oosting J D , et al. For Debate: Personalized Health Care: As Exemplified by Home Sodium Measurements in a Child with Central Diabetes Insipidus and Impaired Thirst Perception[J]. Pediatric endocrinology reviews: PER, 2018, 15(4):276-279.
3. Martens A L , Marije R , Tjabe S , et al. Modeled and perceived RF-EMF, noise and air pollution and symptoms in a population cohort. Is perception key in predicting symptoms?[J]. The ence of the Total Environment, 2018, 639(15):75-83.
4. Ognjen R , Jaeryoung L , Miles D , et al. Personalized machine learning for robot perception of affect and engagement in autism therapy[J]. Science Robotics, 2018, 3(19): 6760-6769.
5. Vlasceanu, George Mihail, Iovu, Horia, Ionita, Mariana. Graphene inks for the 3D printing of cell culture scaffolds and related molecular

arrays[J]. Composites, 2019, 162(1):712-723.

6. Nicolás Garrido, Irene Hervás. Personalized Medicine in Infertile Men[J]. Urologic Clinics of North America, 2020, 47(2):11928-11934.
7. Cornett E M , Turpin M A C , Pinner A , et al. Pharmacogenomics of Pain Management: The Impact of Specific Biological Polymorphisms on Drugs and Metabolism[J]. Current Oncology Reports, 2020, 22(2):11-21.
8. Ferraz R M P , Roland V D T , Pereira A , et al. The effect of fatigue and duration knowledge of exercise on kicking performance in soccer players[J]. Journal of Sport and Health ence, 2019, 8(6):567-573.
9. Kim D H , Choi S S , Yoon S H , et al. Ultrasound-Guided Genicular Nerve Block for Knee Osteoarthritis: A Double-Blind, Randomized Controlled Trial of Local Anesthetic Alone or in Combination with Corticosteroid[J]. Pain physician, 2018, 21(1):41-52.
10. Sadeghi S A , Lee S , Karava P , et al. Bayesian classification and inference of occupant visual preferences in daylit perimeter private offices[J]. Energy and Buildings, 2018, 166(5):505-524.
11. Stojanovic-Tasic M , Latas M , Milosevic N , et al. Is Balint training associated with the reduced burnout among primary health care doctors?[J]. Libyan Journal of Medicine, 2018, 13(1):89-97.
12. Ramos-Hryb A B , Bahor Z , Mccann S , et al. Protocol for a systematic review and meta-analysis of data from preclinical studies employing forced swimming test: an update[J]. Rmd Open, 2019, 3(1):11-20.
13. Pedro Ruymán Brito Brito, Esther García Tesouro, Domingo Ángel Fernández Gutiérrez, et al. Validación de la Escala de Incertidumbre ante la Enfermedad en pacientes y acompañantes que acuden a un servicio de urgencias[J]. Emergencias Revista De La Sociedad Española De Medicina De Urgencias Y Emergencias, 2018, 30(2): 275-281.
14. Kiat J E , Dodd M D , Belli R F , et al. The signature of undetected change: an exploratory electrotomographic investigation of gradual change blindness[J]. Journal of Neurophysiology, 2018, 119(5):1629-1635.
15. Elisabeth B. Marsh, Erin Lawrence, Argye E. Hillis. Pre-Stroke Employment Results in Better Patient-Reported Outcomes After Minor Stroke[J]. clin neurol neurosurg, 2018, 165(8):38-42.
16. Pitzalis S , Strappini F , Bultrini A , et al. Detailed spatiotemporal brain mapping of chromatic vision combining high-resolution VEP with fMRI and retinotopy[J]. Human Brain Mapping, 2018, 39(7):2868-2877.