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Web Expert System for Nutrition Counseling and Menu Management[*]

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ABSTRACT

This study was conducted to develop a web expert system for nutrition counseling and menu management. This program manipulates a food, dish and menu and search database that has been developed. Clients can select a recommended general and therapeutic menu using this system. The web expert system can analyze nutrients in menus and compare nutrient contents of menus with Korean Recommended Dietary Allowances. It can access the food, dish and menu database. The expert menu database can insert, store and generate the synthetic information of age, sex, and therapeutic purpose of disease. With investigation and analysis of the client's needs, the menu planning program on the internet has been continuously developed. This system consists of the database that reaches to the food composition, the dishes and the menu. Clients can search food composition and conditional food based on nutrient name and amounts. This system is able to draw up the food with its order in dish. The menu planning can be organized and nutrients analysis can be compared with Korea Recommended Allowance. This system is able to read the nutrient composition of the each food, the dish and the menu. The results of analysis is presented quickly and accurately. Therefore it can be used by not only usual people but also dietitians and nutritionists who take charge of making a menu and experts in the field of food and nutrition. It is expected that the web expert system can be useful of nutrition education, nutrition counseling and expert menu management. (*J Community Nutrition* 7(2) : 107~113, 2005)

KEY WORDS : web expert system · nutrition counseling · menu management.

Introduction

Some off-line programs on menu planning, nutrition analysis and nutrition education counseling have been developed and used (Han, Rhee 1993b ; Han 1997a ; Han 1997b ; Hong 1989 ; Hong 1996 ; Kang et al. 1998 ; Kang et al. 1999 ; Kolasa, Miller 1996 ; Peter et al. 1998). Similar programs on the internet are insufficient (Choi 2000). Therefore the system based on the internet that has a friendlly user interface and accepts the needs of clients is required as soon as possible (Hong, Hwang 2001).

In the case of the USA, as a program based on internet, the food composition table from the USDA is commonly used. Cyberdiet services food nutrition information and menu and some web sites have meal analysis functions, but those are insufficient (Lee, Nieman 2003). Nutrition related programs based on internet were developed such as the analysis of a food intake and nutrition screening system (Han 2000), a web-based internet program for nutritional counseling and diet management of patient with diabetes mellitus (Han, Jeong 2004), food exchange database construction and search system (ENECC/E-Food Exchange) based on internet (Hong et al. 2003), e-food exchange database construction of commonly used foods and search system (Hong et al. 2004) and menu planning and recommended menu search system (MenuGen) of the National Rural Living Science Institution in Rural Development Administration (Hong et al. 2004 ; National Rural Living Institute). In addition, there are the statuses of eating habits, analysis of eating habits, obesity, calorie expenditure and nutrient analysis of menus in the internet program of the nutrition computing (Hong, Kim 2004). But the developed programs are insufficient in menu planning, menu analysis and management of recommended menu. Users

have trouble to input food or dishes and can not have nutrient analysis, storing and modifying the data. So, as soon as possible, the program is required to be able to make menu planning and to manage the eating.

In this study, we developed the internet-based food, dish and menu management expert system for nutrition management and nutriton counseling (Hong 2005). This system considers the sex, age and disease condition and create general menu and therapeutic menu for disease. We expect that the web expert system will contribute to health and nutrition improvement.

Materials and Methods

1. Development environment and database

1) Development environments

Table 1 shows the development environments of servers and clients. The operating system for servers is Linux. The client operating system is the Microsoft Windows series. The web server is Apache. Development languages are PHP, Javascript and HTML. The database is MySQL. Clients can access the web expert system using internet browsers.

2) Food, dish and menu database

Table 2 shows the database composition. The web expert system database is composed of food, dishes and menus. The food composition table is provided from the National Rural

Living Science Institution in Rural Development Administration (National Rural Living Science Institution 2001). The total number of food constituents is 2,339. The dish database is based on the results of the diet assessment system (National Rural Living Science Institute 2000) and CAN-Pro program ver 2.0 (The Korean Nutrition Information Center 2002) And in modifying the results, it has 24 categories from rice to others. Dish codes are divided into three, grand · middle-range · specific classification. The menu database uses the recommended menus which are the results of the studies on developing the web-based Korean style dietary management system : MenuGen (National Rural Living Science Institution 2002 ; Hong et al. 2004). These are composed of menus according to the client's characteristics and therapeutic menus
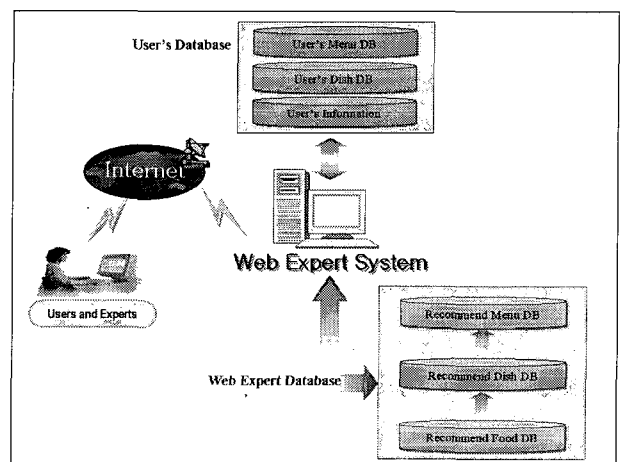
2. System architecture of the web expert system

Fig. 1 shows the system architecture of the web expert system. The database is composed of user information, user menu database, recommended menu database, dish database and food database.

3. The scenario of menu planning by the web expert system

The web expert system is based on rules and cases. The recommended menu is based on pre-constructed cases. Menu properties are adjusted as client preferences. The web expert system verifies that the assessment of nutrients and calories is relevant to the properties of users. Fig. 2 shows the process of menu planning.

Fig. 2, (1) is a step to input the user's sex, residential area, income and age. (2) is a step to search the menu which is relevant to the user's properties from the recommended menus

Table 1. The development environment of server and clients

Server		Clients		
OS	Linux	OS	·	Windows (95, 98, 2000, XP, etc.)
Web server	Apache	Client's environment		above Internet Explorer 5.0
Development languages	PHP, Javascript, HTML			
Database	MySQL			

Table 2. Web expert system database construction

Food	(1)	The food composition table from the national rural living science institution in rural development administration (The Sixth Revision, 2001)
Dish	(1)	Dish categorization
	(2)	Dish constituents and nutrient quantity database' construction
	(3)	Recommended dishes and user dish database construction
Menu	(1)	Characteristic recommended menus
	(2)	Recommended menu database construction
	(3)	Therapeutic menu database construction

Fig. 1. The system architecture of the web expert system.

(8). (3) is a step to select a menu among the recommended menus. (4) assesses the nutrients and calories of the menus, the dishes and foods. This step verifies that the planned menu is relevant to the user's properties. (5) completes the menu planning. By composing the dish (9) using the food database (10), a recommended menu database is made. The stored menu in (11) is included in the recommended menu database. Anyone can use it. Case Base (6) is used when a user searches the recommended menu and selects the menu.

Results and Discussion

1. Menus of the web expert system

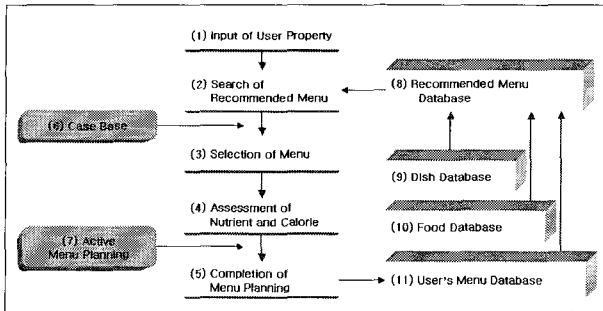Table 3 shows the menus of the web expert system. The

Fig. 2. Scenario of menu planning by the web expert system.

main menus are (1) Menu Management, (2) Dish Management, (3) Food Management, (4) Nutrient Analysis. Each main menu has its sub menus. And the sub menus have some node menus. As shown in Table 3, some functions are shared in each function for common purposes. For example, nutrient analysis is a shared function to Menu Management and Dish Management, etc. The web expert system provides a dynamic view and informative results.

2. Main screen of the web expert system

Fig. 3 is the main screen of the web expert system (http://nutrition.ulsan.ac.kr/webnutrigen/). This screen is for users. The nutrient database in food, dish and menu that a user can
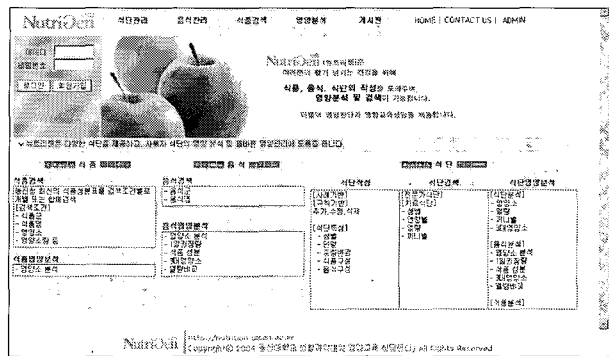
Fig. 3. Main screen of the web expert system.

Table 3. The menus of the web expert system

Expert menus		
Main contents	Sub contents	Specific contents
Menu management	Menu planning	(1) User menu
		(2) User dish
		(3) Recommended menu
	(1) Menu search	(1) User menu search
	(2) Nutrient analysis	(2) Recommended menu search
		(3) Search for menu
		(4) Nutrient analysis for menu
		(5) Nutrient analysis for dish
		(6) Nutrient analysis for food
	Comparing a daily recommended nutrition quantity	(1) Comparing a daily recommended nutrition quantity
		(2) View of nutrient analysis
Dish management	Dish input and search	(1) Dish input, delete, modify
		(2) Dish search
	Nutrient analysis of dish	(1) Nutrient analysis
		(2) Photo of a portion
Food management	Food input and search	(1) Food input, delete, modify
		(2) Food search
		(3) Conditional search of food
Nutrient analysis	(1) Nutrient analysis	(1) Nutrient analysis for menu
	(2) Foodstuffs analysis	(2) Nutrient analysis for dish
	(3) Comparing with RDA	(3) Nutrient analysis for food
		(4) Comparing a daily recommended nutrition quantity

use is made by experts. The main functions of the system are menu management, dish management, food management, search, and nutrient analysis. The recommended menu and dishes are made by experts. The web expert system aims to make use of an expert's menus and dishes, and to provide relevant menu planning and nutrition counseling. The system is concentrated on the informative functions.

3. Menu planning with the web expert system

Fig. 4 is a screen of menu planning. The top screen is divided into 4 frames. Each frame is numbered as its operation characteristic for a convenient user interface.

1) Selection of dish classification

Fig. 4, ① is a selection of dish categories. This is classified by meals like breakfast, lunch and dinner. A user can search a dish by selecting each group from the first and the second categories. Also, a user can input the dish name directly to find it. In the dish category, the grand dish classification is classified by 14 groups, such as rice and soup. The rice has middle-range classifications like a crust of lightly scorched boiled rice, lightly scorched dried rice, plain rice, rice with glutinous rice, etc. Like this system, all dishes are classified into the grand, middle-ranged, and specific categories. This classification is modified based on the "diet assessment system of National Rural Living Science Institute" or "Can Pro".

In case of a dish search, users can search the dishes with the full or partial-word. Single food name searching is impossible. Retrieved food or planning dishes can be added to a current menu. After menu planning and storing, the menu pattern is given automatically as a dish classification. This automatic pattern is the initiative try in internet-based menu planning. Users or experts can add the contents of recom-

mended menus or user menus in the search menu. And they can modify and add the rate or quantity of current menu's dishes and each food.

2) Selection of dish

Fig. 4, ④ shows the results that the selected dish is added to the current menu. It is the result of searching according to the conditional input for dish selection function. In the web expert system, experts or users can follow by adding work :
(1) categorical dish selection, (2) recommended menu searching and adding, (3) meal searching and adding, (4) dish searching and adding, (5) single food searching and adding, (6) making a single food and adding it.

3) Detailed information of menu

Fig. 4, ③ is a detailed view of dishes in a current menu. In case of changing the total weight of a current menu, an expert is able to change the total weight to the weight, percentage and user's degree. Adding or deleting the dishes in a current menu is possible. Also, the rates of calories, fat and proteins are presented. And the sum for a current menu, for meals and for dishes are calculated. The rates and percentages of carbohydrates, proteins and fats in whole menu are showed by a bar graph. In ④, the name of the current planning menu is created automatically with a combination of all included dishes and total calories. When a dish is added to a current menu, the menu name is changed simultaneously.

4) Information of menu

Fig. 4, ④ shows the menu properties. There is a menu planning date and a menu applying date. Users or experts can select each property. Age properties have general age groups with infants. In case of women's ages, the age groups are divided into pregnant or not and the first or second half of pregnancy. The planned menu is stored in the database. The properties of recommended menus, it is not sufficient to provide the menus which a user needs. For a more intellectual menu planning, we consider the following factors : user's activity, a clinical history and a propensity of dish intake.

4. Nutrient analysis and storing of menu

The function of menu planning has a view of recommended energy and a view of nutrient. If a user does not select the menu properties, the criterion of nutrient analysis is based on the 20 − 29 years of age and a male. Fig. 4 shows the view of recommended energy and nutrients.
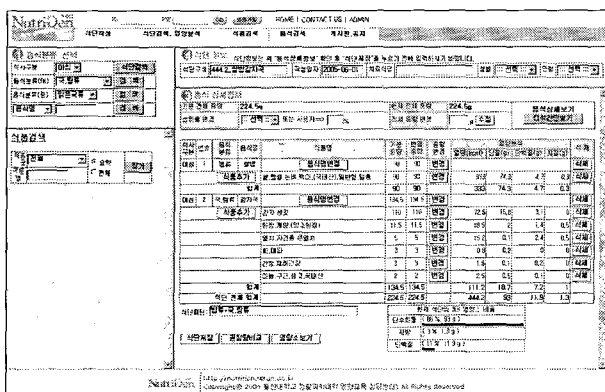

Fig. 4. The menu planning screen of the web expert system.

1) Comparing with recommended energy

This is comparing and analyzing a daily nutrient recommend quantity of a planning or planned menu. For a user's age and sex, the web expert system calculates the sum of each meal such as breakfast, lunch and dinner. Then, the web expert system compares the total energy with a daily nutrient recommend quantity.

2) Comparing with nutrient

There is a nutrient analysis of foodstuffs in each dish. Also, it provides information of foodstuffs in a current menu. If needed, it is possible to modify and delete the current menus, dishes, and foodstuffs.

3) Storing of menu

When the menu planning is completed, the web expert system stores the menu as a menu properties. Stored menus can be used in menu searching, menu modification and new menu planning.

5. Menu search

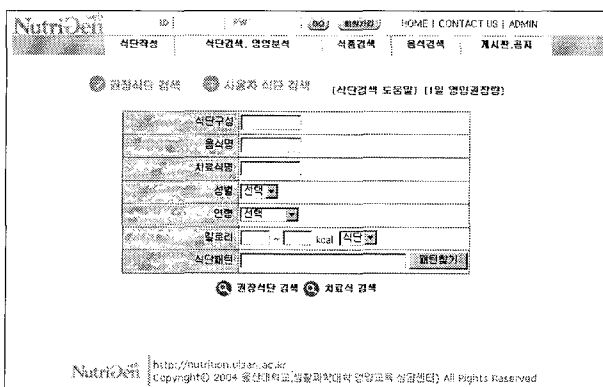Fig. 5 is a screen of menu search. The conditional items of

Fig. 5. A screen of menu search.

Fig. 6. Comparison a current menu with the recommended dietary allowance.

a menu search are season, residential area, calories of menu or meal, user's income, sex, age, menu name, dish name, the object of a menu and the patterns of a menu. In this search process, recommended menus and therapeutic menus are available.

Fig. 6 is a comparison screen of a current menu with the Korean Recommended Dietary Allowance (2001). The screen shows the dish names, quantities and nutrient analysis data. Also, it shows the sum of breakfast, lunch, dinner and the comparison of daily recommended nutrient quantity. The rate is presented as a percentage. On the bottom of the screen is the calorie rates of three main nutrients. Fig. 7 is a screen of nutrient analysis of a current menu. In a detailed view, there are dish names, food names, quantities of foods, dishes and menus, calories and three main nutrients. Also, the web expert system shows the rates of the three main nutrients as a bar graph. Besides, the system provides a comparison analysis with the recommended nutrient quantity and a view of nutrient analysis.

6. Dish search and management

Fig. 8 is a screen of dish search and management. It is a search result in order of cooked rice, boiled rice with assorted

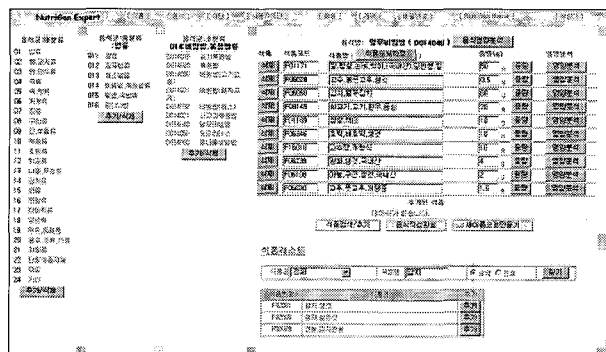**Fig. 7.** Nutrient analysis of a current menu.

Fig. 8. Dish search and management of the web expert system.

Table 4. Food management and search of the web expert system

Food management and search	Food group
	All groups, cereals, potatoes and starches, sugars and sweeteners, pulses, nuts and seeds, vegetables, mushrooms, fruits, meats, eggs, fish and shellfish, seaweeds, milks, oils and fats, beverages, seasonings, prepared foods, others
	Food code
	Food name : Korean, English
	Calorie : range
	Nutrient
	Protein, fat, non-fibrous, fiber, ash, calcium, phosphorus, iron, sodium, potassium, retinol, β-carotene, thiamin, riboflavin, ascobic acid, niacin
	Search with daily foods in database
	Search with total foods in database
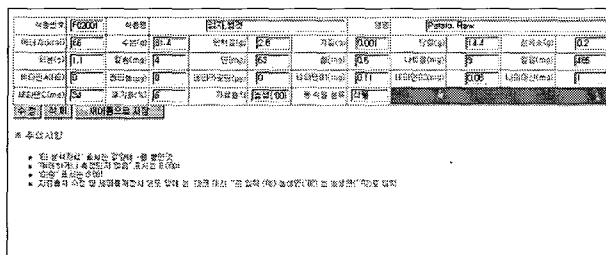
Fig. 9. A screen of food management.

mixtures, fried rice and fried rice with kimchi. It is possible for a user to search dishes by dish name or dish classification. Users can change or modify the dish name, foodstuffs of a dish and quantity of foodstuffs. And a user can analyze nutrients of dishes and food. The web expert system provides a screen print-out and view of a portion.

7. Food management and search

Table 4 shows the food management and search contents. Food management and search has input food composition data and conditional search items such as food group, food code, Korean food name, English food name, calorie and nutrient. And food is divided into daily foods and total foods in the database. Fig. 9 is a screen of food management.

Summary and Conclusion

The web expert system is a nutrition counseling and menu management expert system based on the internet. The friendly user interface was considered. It is composed of recommended menus. The food, dishes and menus are the fundamen-

tal data to assess the nutrient analysis. Experts or users can search, add, modify and delete the fundamental data. Using the database is extensible and is expandable. We add searching conditions to verify the detailed needs of experts. We have transformed the extremely small quantities and source of data to machine-readable data. These are to reduce database errors.

We expect that the web expert system will contribute to nutrition counseling and expert menu planning.

We consider the following future works :

(1) transform the web expert system to an English version that can introduce the Korean foods, dishes and menus to foreign countries.

(2) complement the storing data and statistical function to a user's computer.

(3) vary the databases of food, dishes and menus.

(4) add a change analysis function to watch the nutrition status of users.

(5) upgrade continuously to accept the needs of users or experts.

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